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FLIGHT

AIRCRAFT, SPACECRAFT, MISSILES

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IN THIS ISSUE

The Balance of Power 452
Dart-Powered Executive 456
Mobile and Agile: the Fiat G.91 461
Farming by Air 462
Vulcan B Mk 2 464
Hops and Flights 468

Information from Space

BRITISH scientists have proved notably skilful in extracting information from other people's Earth satellites and space probes. Professor H. S. W. Massey has listed the high-quality observations of the first Soviet satellites by radio, radar and optical methods, which led to new information on the Earth's ellipticity; valuable contributions to knowledge in the fields of air density variability and ionospheric behaviour; the vital importance of the Jodrell Bank radio telescope in receiving signals from the U.S. lunar probes; and the establishment of a world data centre at Slough. In fact, there is no aspect of the tracking, telemetry reception and analysis of orbit data which has not been studied; and results have exceeded the most optimistic expectations.

As for suggestions that Britain should embark upon her own satellite programme, the Government is apparently convinced, and rightly so, that the results would not justify the expense. Recent resignations have been too readily linked with the lack of a national programme; but plans should be considerably clearer by the end of this year, which is to see two major astronautics meetings in London. Not only is the International Astronautical Federation holding its tenth congress in September, but this is to be preceded by the first Commonwealth spaceflight symposium. It is already obvious that, to achieve useful results over a wide field, any British space-research programme must be considered in terms of a Commonwealth effort.

Tour of Duty

FIFTY-FOUR seems a youthful age for a man to vacate the managing director's chair, especially after occupying it for only four years. But unlike commerce, Service life has inexorable rules. So at the end of 1959 the Air Ministry will say farewell to Marshal of the R.A.F. Sir Dermot Boyle and on January 1 next year welcome Air Chief Marshal Sir Thomas Pike as the new C.A.S.

As with sovereignties, it is a case of "The king is dead: long live the king"; emphasis is placed more on the office than on its holder. And Sir Thomas is extremely fortunate in taking over from a predecessor who has been (to retain the regal metaphor) "every inch a king." Sir Dermot has led the Air Staff through a period of great doctrinal change. Explaining this in the Prospect conferences was a splendidly imaginative stroke; and his appearance in the TV film *This is Your Royal Air Force* showed that he could expound policy with persuasion as well as direct it with skill.

Sir Thomas Pike, at 52, fits well into that pattern of experience and youthfulness which the junior Service has established for its officers in forty-one active years. As head of Fighter Command he has seen and directed great changes: yet only 18 years ago he was himself "one of the boys," having left the Air Ministry to command a night-fighter squadron.

We wish the new C.A.S. well as he attains the loftiest level of command. As the new leader of the new R.A.F. Sir Thomas (Tom Pike to his peers) will need all the wisdom and courage that he has consistently displayed in Her Majesty's service. Matters of the greatest moment will be presenting themselves, in respect of equipment, structure, planning and manning, before he, in turn, completes his tour of duty.

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FROM ALL QUARTERS

Encouraging Start

EXPORTS by the British aircraft industry during February (£12,528,528) brought the 1959 total so far to £25,540,035, a record for the first two months of any year. This total was almost 6 per cent up on last year's equivalent figure, which itself showed an increase of 45 per cent over the January-February total for 1957.

The February figure was made up as follows: aircraft and parts £7,163,367; engines £4,788,260 (the second highest ever achieved in a month); electrical equipment £298,441; instruments £205,434; and tyres £73,026. India was the best customer, spending £1,420,204 on aircraft and parts, followed by Switzerland (£623,873) and West Germany (£614,590).

John Brodie

ONE of the best-loved characters and most notable engineers in the British aircraft industry, John L. P. Brodie, M.I.Mech.E., F.R.Ae.S., Hon.M.S.L.A.E., died on March 23 after a brief illness at the early age of 59. He had been engineering director of the de Havilland Engine Co. Ltd. since its formation in 1944, and only seven weeks before his death had delivered the first Halford Lecture on his admired colleague and chief the late Maj. Frank Bernard Halford, whose right-hand man he had been for 32 years.

Mr. Brodie

John Brodie served his apprenticeship during the First World War with Arrol-Johnston, the Dumfries car manufacturers; then he was in the R.A.F. for a short period as a fitter-instructor. His first contact with Frank Halford came during those war years when he worked on the design of the Beardmore-Halford-Pullinger engine, later to go into production as the Siddeley Puma.

This association with Halford was renewed in 1923 when Brodie joined him in London as a designer. They worked on both car and aero engines, and it was through the latter that they came into contact with Capt. (now Sir Geoffrey) de Havilland. To meet his requirements for a practical light aeroplane, Halford evolved the Cirrus engine from the Airdisco, and Brodie's first visits to Stag Lane were in connection with installing the Airdisco in the D.H.51.

In 1926 Halford and Brodie designed the de Havilland Gipsy engine. Its success founded the great family of Gipsy engines, with every type of which John Brodie was directly concerned during more than three decades.

Early in the Second World War, while still assistant chief designer to Halford, Brodie took over the administration of the D.H. Merlin Repair Department, which reconditioned 9,000 of these Rolls-Royce engines; then in 1941 he assumed the engineering management of the D.H. Engine and Propeller Divisions.

In 1941 Halford, Brodie and Dr. E. S. Moult were commissioned to start design work on the Goblin, and the first engine ran on April 13, 1942, just 248 days from the issue of the first drawings. Brodie was now faced with making a dependable engine out of a gas turbine, and this he duly achieved: development of the Goblin, Ghost, Gyron axial-flow engine and the present Gyron Junior were all his responsibility, both before and since the formation of the D.H. engine company in 1944. To these were added, from 1946, the engineering development of the D.H. family of rocket engines and more recently the Gnome turboshaft engine.

He felt profoundly the loss in 1955 of his chief Frank Halford; but by that time the engineering team, with the design leadership of Dr. Moult as chief engineer, had gained great technical strength, and John Brodie was able to devote more time to human relations, giving by his warm personality encouragement and support to all with whom he came into contact.

ACHIEVEMENT REWARDED: As recorded below, the 1959 Hulton Award was handed to Sir Geoffrey de Havilland in London on March 25. Sir Geoffrey (second from left) is with Sir Edward Hulton (left), Lord Kindersley and Sir Gerard d'Erlanger

Hulton Award Presented

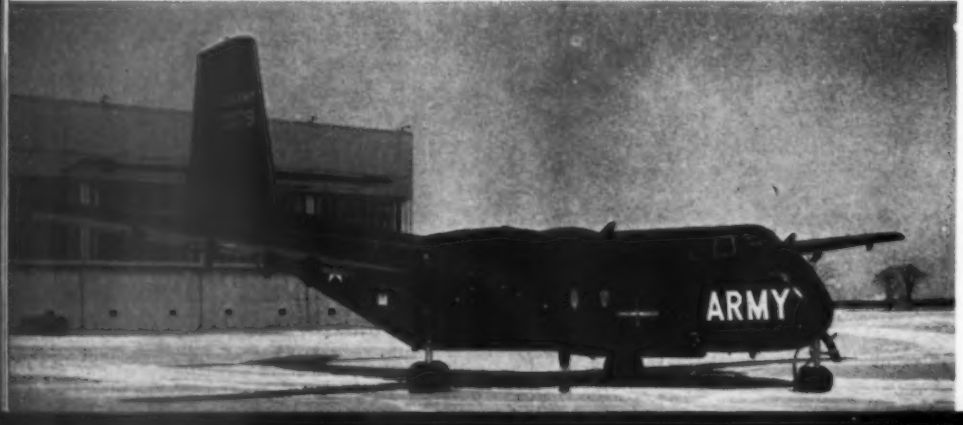
IN London on March 25 the Hulton Achievement Award for 1959 was handed by Sir Edward Hulton to Sir Geoffrey de Havilland. Sir Geoffrey was receiving it on behalf of the de Havilland Aircraft Co. Ltd., Rolls-Royce Ltd., and the British Overseas Airways Corporation, respectively responsible for building, powering and operating the Comet. Silver medallions were handed to Sir Geoffrey, Sir Gerard d'Erlanger and Lord Kindersley.

In a brief speech Sir Edward Hulton said, "It is hoped this award will do something to tell the world that some of the features of modern life are British. The Comet 4 is a shining example of the British virtue of teamwork."

Six judges were unanimous in making the award: Lord Brabazon of Tara, president of the Royal Institution of Great Britain; Col. Sir Charles Ponsonby, vice-president of the Royal Commonwealth Society; Lord Rootes, chairman, Rootes Ltd.; Sir Miles Thomas, chairman, Monsanto Chemicals Ltd.: Mr. C. S. Garland, immediate past president, National Union of Manufacturers; and Dr. R. W. Holland, vice-president of council, the Royal Society of Arts.

£1½m Marconi Order

THE U.S. Government has placed a contract worth £1,250,000 with Marconi's Wireless Telegraph Co. Ltd. for a mobile microwave telephone and telegraph communication system to be installed in Britain for use by the U.S.A.F. The equipment involved is the new HM.510 series, providing 240 telephone channels and working in the 4,000 Mc/s band. Reference is made on page 472 to some other recent Marconi orders.



IN BATTLEDRESS: The first of the five YC-1B Caribou aircraft ordered by the U.S. Army from de Havilland Aircraft of Canada is pictured here at Downsview amid last month's late snow. It first flew, for 90 min, on March 13. Powered by two Pratt & Whitney R-2000 piston engines, it closely resembles the two previous Caribous, except for its khaki drab finish and lack of pitot tubes and aerials

HSS-2 is the U.S. Navy's designation for this twin-turbine amphibious helicopter by Sikorsky. Mission: anti-submarine; engines: General Electric T-58-6s of about 1,050 h.p. Maker's designation is S-61

New Avro Directors

FULL details of the executive changes at A. V. Roe & Co. Ltd., to which brief reference was made in a late-news paragraph last week, are as follows. Mr. J. A. R. Kay has been appointed managing director and Mr. S. G. Joy, company secretary, becomes director and general manager. There have been five new appointments to the Board: Mr. J. T. Lidbury and Mr. S. D. Davies become directors, and Mr. A. Sewart, Mr. J. R. Ewans and Mr. R. H. Francis executive directors.

Mr. S. G. Joy

Mr. Kay and Mr. Lidbury, who is general manager of Hawker Aircraft Ltd. at Kingston, were recently appointed joint managing directors of Hawker Siddeley Aviation Ltd. (*Flight*, January 30). Mr. Joy has been secretary of A. V. Roe for the past twenty years; his new post means that he will assume a much wider control of the day-to-day activities of the Manchester factories. Mr. Davies is best known as designer of the Vulcan; he was succeeded as chief designer by Mr. Ewans, who has been responsible for the Avro 748. Mr. Sewart is assistant general manager (missiles) and Mr. Francis is chief engineer of the Avro Weapons Research Division.

"Gus" Walker's New Post

IT was announced last week that A.V-M. G. A. ("Gus") Walker is to become Chief Information Officer at Air Ministry in June. He has been A.O.C. No. 1 Group, Bomber Command, since October 1956; he had a distinguished wartime career and before the war was an English rugby international.

The present C.I.O., Mr. L. M. MacBride, is to become Chief Publicity Officer. This is a new post concerned with the publicity aspects of recruiting.

Saro Resignations

THE resignation of Mr. P. H. Leyton as chief rocket development engineer, Saunders-Roe Ltd., was announced on March 16. Mr. Leyton, who has been in charge at the Black Knight test site at High Down, Isle of Wight, has taken up the position of director of engineering with Black & Decker Ltd. In a letter to *The Times* on March 21, he attributed his resignation to the lack of an official British policy on space research.

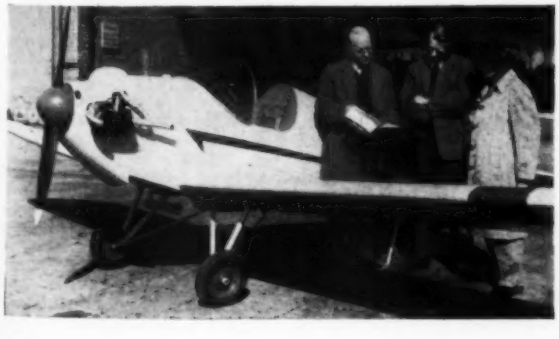
This was followed on March 23 by the resignation from Saunders-Roe of Mr. M. J. Brennan, the chief designer. Mr. Brennan later denied that his resignation had any connection with that of Mr. Leyton, or that it was a protest against Government rocket policy. He said: "I have resigned to make myself available for an appointment with one of the larger aircraft companies." Mr. R. Stanton-Jones has been appointed acting chief designer at Saunders-Roe in succession to Mr. Brennan.

Counting the Cost

GOVERNMENT expenditure on airfields and aircraft has been in the news recently. In the Air Services Appropriation Account 1957-58 (H.M.S.O., 3s) some details were given of the rising cost of the new R.A.F. airfield at Gan in the Maldive Islands; and in Parliament last week there were questions about Ministry of Supply losses on aeronautical research and development.

Sir Edmund Compton, the Comptroller and Auditor-General, in his report on the Accounts says that the cost of building an airfield and radio installations in the Maldives was now expected to be £3,800,000 against an estimate of £2,700,000 in June 1957. The figure had risen from £3,150,000 since January last year. Major reasons for the increase had been given as (1) the higher cost of providing aggregate for the runway because the Ministry had not been allowed to develop causeways between Gan and adjoining islands, where it could have been won at lower cost; and (2) the decision to extend the paved length of the runway by 1,200ft. Accounts for the air services as a whole show a surplus to be surrendered to the Exchequer of £11,212,646.

When it was asserted in the House of Commons on March 23 that the Ministry of Supply underestimated the cost of its development projects, the Parliamentary Secretary (Mr. W. J. Taylor) replied that the Ministry tried to analyse precisely what a particular project entailed and to bring "more informed critical judgments" to bear on estimating its cost at each stage. This was in answer to questions by Mr. Roy Mason (Lab., Barnsley); and in answering further ones by Mr. Frank Beswick (Lab., Uxbridge), about penalty clauses in contracts and the efficient checking of estimates, Mr. Taylor said that development contracts for aero-engines did not include a penalty clause "because the work to be done by its very nature renders initial estimates and calculations liable to a margin of error."



The M.o.S. "Fleet"

ASKED in Parliament last week about the number of aircraft held by the Ministry of Supply, to what extent they were being utilized and what rundown was visualized this year, the Parliamentary Secretary said in answer that the number was 411; they were fully utilized (though there were occasional gaps between tasks); and he did not foresee any significant run-down.

During the last two years there had been a reduction in the holding of more than 150 aircraft. The machines were used for research and development; there was no real discernible waste.

IN BRIEF

It was announced in Bonn on March 24 that the Federal German Defence Ministry had signed a contract with Sud Aviation for 130 Alouettes for the West German armed forces. Other Alouette orders include six for the Royal Netherlands Air Force (two already delivered) and three for an Israeli civil operator.

* * *

Since "Forthcoming Events" (p. 472) went to press, news has come of the postponement of the Brancker Memorial Lecture until September 14.

* * *

Mr. and Mrs. Herbert May of Washington and Pittsburgh, U.S.A., have become the first private owners of a Vickers Viscount anywhere in the world. They purchased their aircraft (a V.700 series) from Lanica, the Nicaraguan airline; it is being converted from 44 to 14 seats and a full executive interior will be installed.

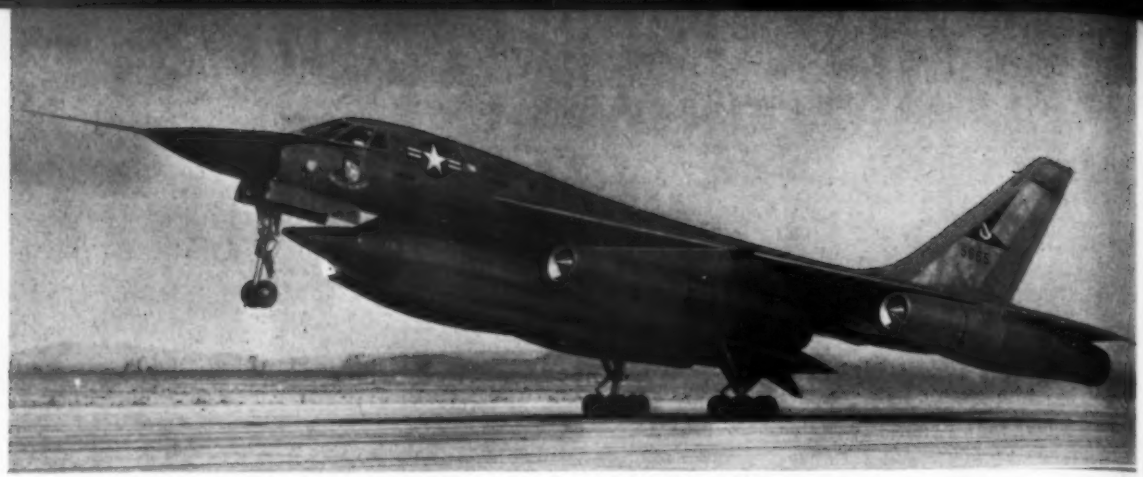
* * *

On March 20 Convair were awarded a further contract from the U.S. Air Force for the development of a nuclear-powered bomber. Convair have had a study contract for several years in association with General Electric, as have Lockheed Aircraft and their propulsion partners, Pratt & Whitney. The two latter companies have now been virtually eliminated, and even Convair are held up pending completion of the basic design parameters of the propulsion system.

* * *

Bristol-Aerojet Ltd., the company which was recently formed by the Bristol Aeroplane Company and Aerojet-General Corporation, is to establish a plant near Kidwelly, Camarthenshire. An industrial development certificate has been granted to the company for a site on the disused airfield at Pembrey. When the company was founded last October, it was stated that Bristol-Aerojet intended to open a British plant for the production of the rocket propellant polyurethane.

***SATISFIED CUSTOMER:** At Croydon Airport on March 23 A. Cdre. G. J. C. Paul, secretary-general of the Air League, took delivery of his personal Rollason Turbulent. From the left, Mr. Norman Jones of Rollasons, A. Cdre. Paul and Capt. R. S. Barnaby*



"Strategic Air Command will soon receive limited quantities of a Mach 2 bomber, the B-58 Hustler"

THE BALANCE OF POWER

MEASURING "THE MISSILE GAP"

By DON ADAMS

HOW strong, in a military sense, is America? Few U.S. citizens seriously doubt the accuracy of recent confident claims by various senior officers and government officials presumably having first-hand knowledge.

There are, however, some who question whether present U.S. defence policies will assure that the balance of power in the future remains on the more friendly side of the Iron Curtain. Voicing opposition to the Administration's existing defence programme are several prominent Congressmen, and a number of otherwise important persons. Key issues in the discussions are (a) the threat posed by a developing Soviet ICBM capability and (b) the alleged "missile gap" facing America in the early 1960s.

The Threat. Recent estimates of Soviet strength have credited the U.S.S.R. with a force of 100 ICBMs by 1961. A total of 500, the same source reports, are to be deployed the following year. According to some observers. these figures represent a 3:1 Soviet advantage in ICBMs in the early sixties. Still greater margins in favour of the Soviets have been forecast for succeeding years. And it is claimed that the Russians will possess a numerical superiority in ICBMs until the U.S. begins large-scale production of the Minuteman and Polaris ballistic missiles sometime around 1965.

How much of a threat is posed by the Russian ICBM force hinges on the degree of effectiveness of the missiles. Optimistic estimates of the reliability of an ICBM suggest that two missiles will have to be directed at each target to insure its destruction; but a few weeks ago Secretary of Defense McElroy opined that it would take four to six ICBM-type missiles to knock out a single target. Assuming his figures to be the more realistic of the two, the Soviet Union *may have* the ability to destroy upwards of 100 targets by 1962. The words "may have" are used since some highly placed sources express considerable doubt that the Russians *will have* that great a capability in the noted time period.

Currently aligned against the Soviet threat—whatever its magnitude—is the considerable armed might of America. Backbone of her deterrent force are the 2,000 turbojet bombers of the Strategic Air Command. Added to this force are naval aircraft aboard fifteen attack carriers, and large numbers of strike aircraft in the Tactical Air Command.

Shortly, deliveries of production Atlas ICBMs will begin, to be followed next year by Titan. Already selected as launching sites for these missiles are seven Air Force bases; Warren, Wyoming; Vandenberg, California; Forbes and Schilling, Kansas; Offutt and Lincoln, Nebraska; and Fairchild, Washington. All of these sites will be equipped with Atlas. The first Titan units are to be deployed at Lowry A.F.B., Colorado; Ellsworth A.F.B., South Dakota; and Mountain Home A.F.B., Idaho.

Construction of a number of atomic-powered, Polaris-launching submarines is already under way. And the Strategic Air Command will soon receive limited quantities of a Mach 2 bomber, the B-58 Hustler.

By the early sixties, the Hound Dog stand-off missile will be available to increase the effectiveness of manned bombers. Soon afterwards, Minuteman and Polaris will be added to the inventory in substantial numbers. Production of a Mach 3 bomber, the B-70 Valkyrie, is also scheduled for that time period.

Are these forces, as now planned, adequate to cope with the expected Russian threat? No, say some critics of the Administration.

The Missile Gap. That the Soviet Union may acquire a numerical advantage in ICBMs within the next few years is admitted by many defence officials. There is not as good agreement, however, on the consequences of such a situation. Whereas the Administration considers—and one would think quite properly so—that the U.S. ICBM force is but a part of an overall defence force, there are those who tend to discount the effectiveness of all weapons except ICBMs. These people would immediately accelerate ICBM production to match the Russians "missile for missile."

Principal bone of contention among professional and amateur strategists alike is the rôle of manned bombers in the next five years. Some believe that S.A.C.'s bombers would be destroyed on the ground before they ever became airborne. Others disagree.

It is understood that at the present time the U.S. bomber fleet is dispersed at 43 main S.A.C. bases within the continental United States. It can be assumed that should an aggressor direct a mass ICBM raid at America a number of missiles would be aimed at the vulnerable bomber bases. On March 8, Secretary McElroy stated in a television programme his belief that an attack by 200 ICBMs would not wipe out all of S.A.C.'s bases. But what about a raid of 500 ICBMs? This number may well be large enough to assure devastation of 43 prime targets. Obviously, if S.A.C. is to remain a potent deterrent force in the sixties, its bombers will have to be aloft at the time the warheads begin exploding.

Fifteen minutes has been widely mentioned as the maximum warning time that could be given of an impending ICBM attack. DEWline radar stations, positioned near the Arctic Circle, would give the warning. Within fifteen minutes, therefore, as many as possible of S.A.C.'s bombers must take off on a retaliatory mission. Approximately 10 per cent to 20 per cent of the Command's fleet are currently on a "ground alert" status, meaning that 200 to 400 bombers could be airborne within 15 minutes. Many persons question whether this number is adequate. Of the aircraft that manage to become airborne, some will never reach their targets, owing to in-flight malfunctions or losses caused by enemy counteraction. Some bombs will also miss their targets. The number of the aggressor's targets that could be destroyed in an initial S.A.C. retaliatory raid would be fewer than 200. How many aircraft are needed? Between 600 and 700 S.A.C. aircraft is the figure sometimes quoted for an "adequate" sized force. According to the Secretary of Defense, the number of aircraft on ground alert will rise to 30 per cent, or about the desired total, by year's end.

Additional bombers could be maintained aloft on an "air alert," but it is an extremely costly process. Representative Flood has been quoted as stating that the cost of keeping S.A.C. on an air alert status could run as high as one billion dollars a year [the U.S. billion is 1,000m—Ed.]. Except in times of known emergencies, such as occurred during the Quemoy, Suez and Lebanon crises, the Air Force is not likely to maintain other than a token force on air alert.

Critics of the Administration's defence policies generally support the concept of "infinite deterrence," a theory discussed in a recent Flight article (pp. 344-345, March 13). Proponents of infinite deterrence, or "counter force strategy," as it is sometimes called, hold that war can be averted only if the U.S. maintains forces so strong that after accepting the first blow it will still retain overwhelming power. Faced with the prospect of suffering ruin in massive retaliatory raids, potential aggressors would be deterred from starting a war. Currently programmed U.S. missile produc-

tion, say the critics, will not result in an "overwhelming" force. The U.S. will lag behind the Russians in ICBM production. Hence a missile gap, and a concurrent danger of war.

Existing American production schedules call for the completion of 200 tactical ICBMs by 1962. Arranged in squadrons of ten weapons each will be 90 Atlas and 110 Titan. Assuming 500 Russian missiles by 1962, the "gap" would be 300 ICBMs.

To close the gap, many people have advocated doubling U.S. production of ballistic missiles. 400 ICBMs would thus be measured against a slightly greater number of Soviet weapons. Approximately $1,000,000,000 is necessary to finance construction of 200 additional ICBMs. Spread over a five-year period, the cost per year would be about $200,000,000.

The money for more ICBMs can come from several sources. Increasing the defence budget beyond the President's request for $40.9 billion dollars is a possibility. The funds might also come from within the existing budget. Perhaps the farmers of America can be persuaded to part with some of the six billion dollars they receive in subsidies; or Veterans' benefits might be reduced —their budget approaches five billion dollars. Both of these sources are politically unattractive, and a more probable—albeit less justifiable—source would be to reduce Mutual Aid funds below the current budget of four billion dollars.

The Administration's Position. Passages from a recent speech by Admiral Arleigh A. Burke very aply state the Administration's policy:—

"There has been considerable concern in this country about a missile gap. Most of this concern has been centred primarily upon a numerical difference between United States missile strength and that of the Soviet Union. However, it is not a *quantitative* gap we should be concerned about. Rather it is a *qualitative* gap we must be careful to avoid. In this connection the United States is ahead of the Russians in retaliatory power; it is far more powerful than the Soviet Union, and this is a status which we can and will maintain.

"There is no point trying to equate our requirements and capabilities with the enemy's. Our requirements are entirely different and our capabilities must be developed around our own needs. We do not need to engage in an endless arms race with the Soviets in ballistic missiles, any more than we have attempted to race them in numbers of submarines or army divisions.

"The really importan. thing about a deterrent force is not numbers but invulnerability; not total numbers built, but numbers we will be able to use. In making our retaliatory forces secure from enemy attack we do not need great numbers of missiles and bombers.

"Whether the USSR has one-half as many or several times as many missiles as the United States, is really academic as long as we have the assured capability of destroying Russia, and as long as the Soviets know it, and are really convinced of it. There is, in fact, far greater psychological advantage for the United States in having this capability than in allowing ourselves to be drawn into a fruitless and unnecessary race on Soviet terms.

"Hiding behind the Iron Curtain the Kremlin can tell us what they want us to know, and they are able to conceal fairly effectively that which they don't want us to know. If they had a particular capability, would they make such statements as to cause us to build an appropriate response to the particular threat? If the Kremlin really intends to exploit an advantage, would it not be better for them to remain quiet and surprise us with deeds rather than words?

"The United States is embarked upon a defence programme aimed at meeting our security needs. By not entering a numbers race with the Soviets on their terms we also avoid the limitless economic drain which such a race would involve.

"We can afford what we must have to afford for United States security, but also, we must spend our funds for what we need. We must apportion our funds carefully to meet all the contingencies facing us."

Another point which is pertinent to the current discussion was made early in March by Secretary McElroy. In response to a question by a member of the House Space Committee, Mr. McElroy stated that it might not always be the U.S. position to allow a potential aggressor to strike the first blow. Two days later the President supported this opinion. *Time* magazine quoted him as saying "The right of self-preservation is just as instinctive and natural for a nation as it is for the individual. Therefore, if we know we are at any moment under a threat of attack . . . then we have to act just as rapidly as possible, humanly possible, to defend ourselves."

Secretary McElroy subsequently mentioned a few specific examples of the type of incident which might prompt the U.S. to consider changing its policy of accepting the first blow. The mounting of a sizeable ICBM attack by an aggressor could not be accomplished without being detected by Allied intelligence agents. Perhaps four to five days of unusually heavy communications, movements of forces, etc., would have to precede any "surprise" attack. And it would be in such a period that the President would be faced with the grave responsibility of deciding whether to accept the first blow—or to deliver it.

Such is the Administration's position. But despite the soundness of their reasoning it is likely that the present American ICBM schedule will be accelerated. The resulting increase in ICBM production in itself will probably not change the status of the Cold War, or significantly increase or decrease the chance of war. It is debatable whether the potential aggressor who would be deterred from starting a war because he faced a force of 400 ICBMs and 2,000 strategic bombers, would not be deterred by a force of 200 ICBMs and 2,000 aircraft. Apropos at this point, Admiral Burke stated: "It is important for us to understand that a cardinal rule of the Soviet leaders is that the destiny of Communism must not be jeopardized by harebrained risk." It is difficult for the average person to regard the starting of a war against a country possessing 2,000 intercontinental bomber aircraft and 200 ICBMs as anything but a "harebrained risk."

BRAZILIAN HELICOPTER

A HELICOPTER, built at the Brazilian Centro Tecnico da Aeronautica at São José dos Campos and designed by Prof. Henrich Focke, recently made its first flight following 40 hours of tethered trials. The pilot was Col. Aldo Weber-Vieira da Rosa, chief of the development section of the Centre. Prof. Focke and many of his engineers have been working since 1952 in Brazil. Focke himself has now returned to Germany and his place has been taken by his associate, Ing. Hans Swoboda.

Powerplant studies for a large convertiplane are now under way, but for the last four years the main effort has been concentrated on the Beija-Flor light helicopter, which is tailored to Brazilian conditions and industrial capability. It is powered by a fan-cooled Continental 225 h.p. engine mounted horizontally in the nose, and the tail controls are characterized by two intermeshing, three-bladed tail rotors set at 45 deg; directional control can thus be derived by differential pitch-changes controlled from the rudder pedals and longitudinal control by collective changes controlled from the stick. A swept vee-tail and ventral fin provide additional control in forward flight. Such an intermeshing-tail-rotor layout is also applied to the Borgward Kolibrie, designed by Focke.

The main drive from the Continental is taken rearwards through a centrifugal clutch and into a reduction gearbox developed from a British-made (Brown) worm-drive back axle for a lorry. Besides having good cooling and lubrication characteristics, this axle produces the 90 deg change of direction for the drive and a built-in reduction of 1:8.4. It runs exceptionally quietly and has an efficiency of 94.7 per cent. The phosphor-bronze worm gear drives the vertical rotor shaft through a freewheel.

The three-blade rotor head has only flapping hinges, other moments being absorbed articulations at about mid-span so that aerodynamic unbalance and ground-resonance are eliminated. The articulations are covered by aerodynamic fairings which provide considerable lift over the inner sections of the blades and thereby allow a greater range of rotor speeds than usual. A dynamic means of stabilizing the rotor is incorporated in the rotor head.

Only lateral control is exercised through the cyclic-pitch column, both directional and longitudinal displacements being produced by the twin tail-rotors, controlled from the rudder pedals and control column.

The test pilot has reported that alterations in power setting and collective pitch can be made from the same lever without requiring any compensating rudder movement. The transmission is also notably free from vibration. The Beija-Flor has been designed to American airworthiness specifications.

Leading Data: Rotor diameter, 29ft 7in; Length, 28ft 11in; Gross weight, 2,260lb; Disposable load (two occupants), 652lb; Max. cruising speed, 187 m.p.h.; Vertical climb, 197ft/min; Ceiling 12,200ft.

The Beija-Flor helicopter (Continental 225 h.p.) in prototype form

Missiles and Spaceflight

RADIATION-BELT RESULTS

Further information concerning the Van Allen belts of radiation surrounding the Earth, resulting from data provided by the Pioneer 4 space probe, was given by Prof. James Van Allen himself in Pasadena, California, on March 20. This region extended farther than had been supposed, he said; the upper band existed from 8,000-55,000 miles from the Earth, and the inner band extended from 1,500 to 3,000 miles. According to data from Pioneer 4 the inner band was by far the more deadly as far as manned spaceflight was concerned. Space travellers would have to be heavily shielded in passing through this radiation, or take advantage of the reduced intensity over the Poles.

MORE MISSILE LAUNCHINGS

On March 18 an Atlas C fitted with one of the new ablating nose-cones was fired from Cape Canaveral. Similar to the pattern developed by the Army Ballistic Missile Agency for the Jupiter, the new cone has a relatively small tip-radius and is much more pointed than the original pattern developed by G.E. for the Thor and Atlas. After experiencing "propulsion and control problems," the Atlas fell into the Atlantic 700 miles from Cape Canaveral (the scheduled distance was 4,500 miles).

Four days later two Thor IRBMs were fired from Cape Canaveral within 20 hr of each other. The first round was a Thor-Able two-stage vehicle, the second stage of which carried a model ICBM warhead; a search was conducted near Ascension Island (5,000 miles down-range) but the cone was not found. The second Thor was a production model and achieved its design range with a dummy warhead. On March 27 a Thor was fired over 1,600 miles from Cape Canaveral, and—for the third time in 26 firings of standard SM-75 missiles—the data capsule was recovered intact.

HAWK REJECTED

Last month the U.S. Joint Chiefs of Staff Committee rejected the Army's proposal to provide all-altitude defence by Nike Hercules operating in conjunction with the Hawk, the latter being employed for destroying aircraft flying at the lowest altitudes. Hawk, the prime contractor for which was the Raytheon Manufacturing Co., is a relatively small solid-propellant weapon guided by C.W. monopulse radar which has the ability to discriminate between moving targets and ground clutter. The American industry has been forcefully promoting this weapon for adoption as a standard type by the NATO countries, and widespread plans for its manufacture in Europe have been unofficially reported. In view of the J.C.S. decision, however, the U.S. Army will not deploy Hawk from fixed installations within the U.S.A.

HOUND DOG

Intended to be the standard cruise-type air-to-surface missile of the U.S.A.F. Strategic Air Command, the North American GAM-77 Hound Dog is the subject of the photograph below, released on March 21. The missile is being developed in two forms, one for electronic countermeasures and the other carrying a megaton warhead for launching against heavily defended targets.

Prime contractor for the Hound Dog programme is the Missile Division of North American Aviation at Downey, California. The airframe owes much to this division's work on the defunct XSM-64 Navaho, and Hound Dog differs from that weapon in the following major characteristics: propulsion is provided by a single underslung turbojet; the butterfly tail is replaced by a vertical fin and rudder; and the entire vehicle is much smaller. Design range is of the order of 350 miles, cruising at between Mach 1.6 and 2.2. Propulsion is provided by a Pratt and Whitney J52 without afterburner, and guidance is effected by an advanced system — primarily inertial — developed by North American's Autonetics division, which is also located at Downey.

The photograph shows a training and test model, aerodynamically representative of the production weapon. Such models have been test flown beneath B-52s, and further work is in hand at Boeing Field, Seattle; McConnell A.F.B., Wichita; and Eglin A.F.B., Florida. The B-52G can carry one Hound Dog under each wing, and the missile is also likely to be carried by other types of aircraft. [Notes on the history and characteristics of Hound Dog were given in *Flight* of December 5, 1958.]

This "training and test model" of Hound Dog, in position below the wing of a B-52, has the same aerodynamic characteristics as the operational missile (news item on this page)

Woomera, March 12: Second successful Black Knight launch (lecture on Black Knight by E. C. Cornford reported below)

FOCUS ON BLACK KNIGHT

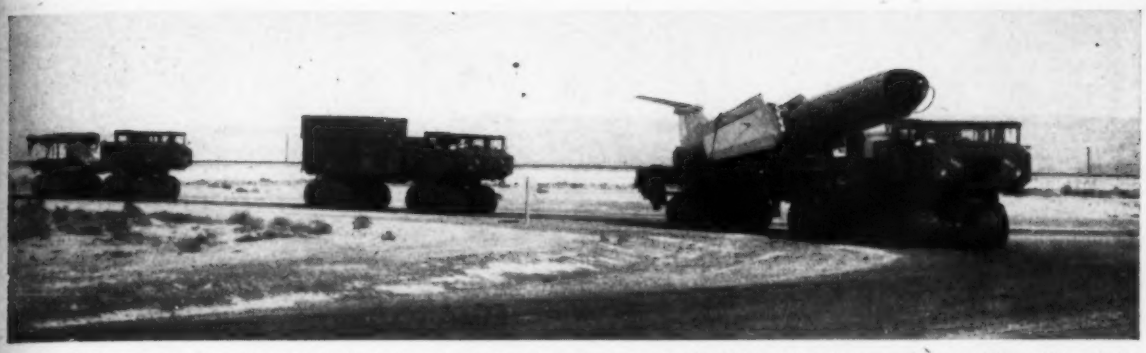
A film produced by the Royal Aircraft Establishment and titled *Black Knight, the R.A.E. Ballistic Rocket Test Vehicle* was shown by Mr. E. C. Cornford to members of the Royal Aeronautical Society in London on Thursday, March 19. This accompanied a lecture on *Long-range Missiles* given by Mr. Cornford, who is head of the Guided Weapons Department at the R.A.E., before the Astronautics and Guided Flight section of the Society.

The first part of the lecture dealt with some of the design problems and possible solutions arising during development of a medium-range ballistic missile such as Blue Streak or Thor. In the second part Mr. Cornford indicated the wide variety of new facilities which are needed to support ballistic-missile development.

Propulsion, structures, guidance, control and re-entry problems were discussed in turn under the design-problems heading. Among the problems mentioned were the choice between liquid and solid-propellants; that between pressure stabilization and mechanical stabilization for the thin shells containing liquid propellants; and that between radar, inertial, or combined radar/inertial systems for guidance (the speaker recommended the combined method).

The film on Black Knight which illustrated the second half of the lecture began with diagrams of the rocket configuration—the basic single-stage vehicle using H.T.P. and kerosine, and a two-stage version in which a second, solid-propellant stage would be added to obtain higher altitudes. On a typical re-entry test, the rocket would have an all-burnt velocity of 12,000ft/sec at a height of 80 miles, would reach a height of 500-600 miles, would re-enter the atmosphere after a flight of about 20 minutes and would have an impact point of some 40 miles from launch.

After showing airframe construction at Saunders-Roe and Gamma 4 rocket engine tests at Armstrong Siddeley, the film illustrated static-firing tests of the vehicle at High Down test site in the Isle of Wight. The rocket was next shown at Woomera (after being transported there by air) being prepared for firing and being launched. Initial study of results was followed by R.A.E. analysis.



Martin missile training (1): a Mace tactical missile caravan seen during exercises in the U.S.A. Mace is powered by an Allison J33 turbojet

Missiles and Spaceflight . . .

THOR CAPABILITY

Answering a question by Mr. Geoffrey de Freitas in the House of Commons on March 18, Mr. Airey Neave, Under-secretary of State for Air, said that the Thor missiles in Britain were expected to become operational "after the successful completion of proving trials in the United States"; they would be manned 24 hr per day; and the annual running cost should be "about £3 million to £4 million, most on pay."

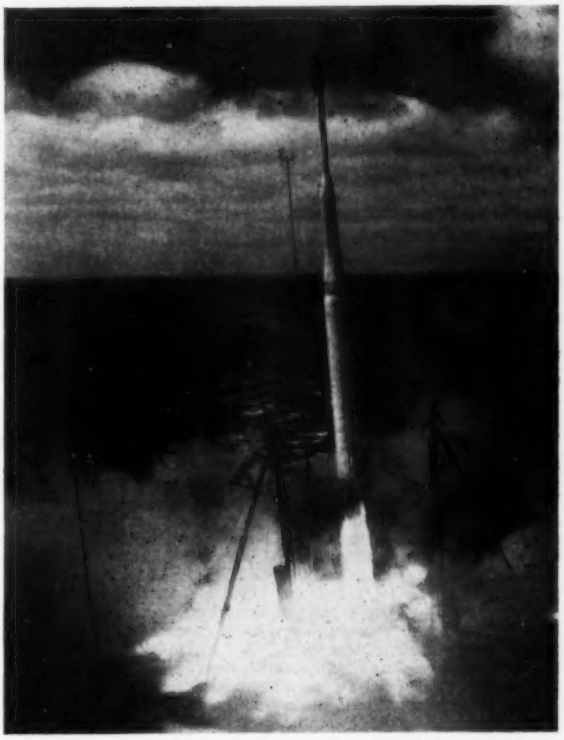
Mr. de Freitas called attention to the statement by the Chief of Staff of the U.S. Air Force that these missiles were already operational and ready to be fired. He later asked "Is it not more and more obvious that these missiles are not satisfactory, that they have not passed their tests and that we should not proceed further in wasting public money on the installation and building of these bases?" Mr. Neave said he did not agree; the tests were going extremely well.

TOO MANY COOKS?

An investigation into "wasteful rivalry and duplication" in U.S. space programmes will begin this month. Hearings will take place before a new sub-committee of the Senate space committee under the chairmanship of Senator Stuart Symington. Announcing the formation of the new group, the chairman of the space committee, Senator Lyndon Johnson, said there were 14 U.S. agencies and commissions with diverse authority or responsibility concerning space programmes.

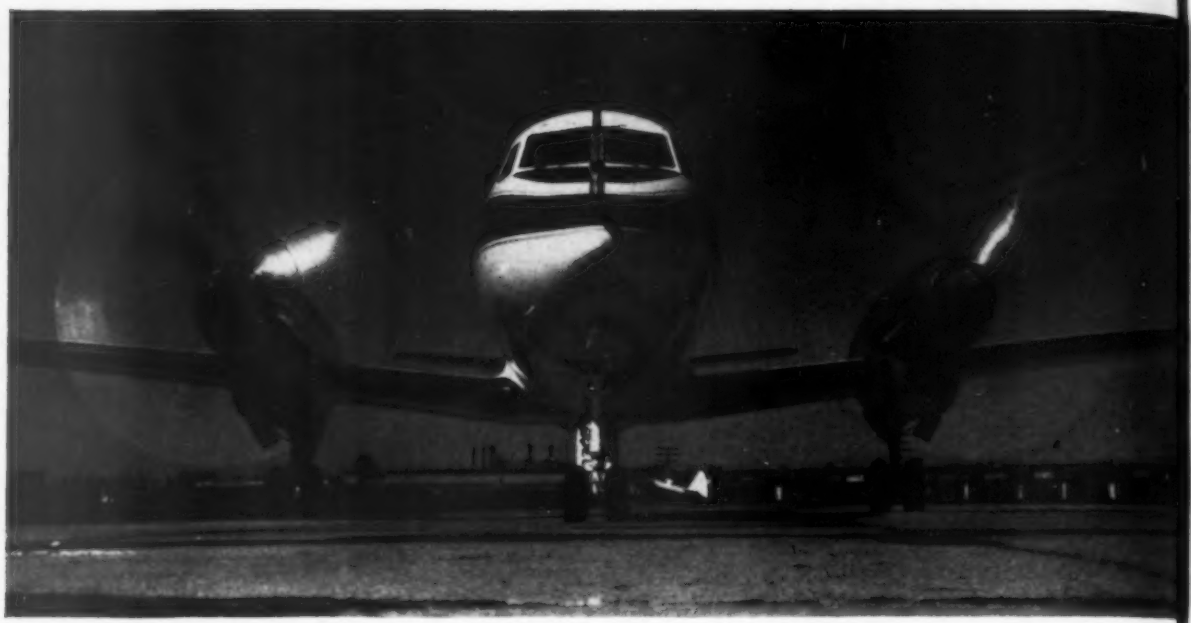
SATELLITES ON FILM

The British Interplanetary Society has produced an instructional film strip on the subject of artificial satellites. Edited by E. T. B. Smith, this is the third in the Society's series, the first two having been devoted to *Rockets and Spaceflight* and *The Viking Rocket*. Now in course of preparation are two further strips concerned with medical aspects of spaceflight, and high-altitude research.



A test firing in the Project Argus programme which, as reported last week, included the explosion of three nuclear warheads at an altitude of 300 miles. The rockets used were modified Lockheed X-17 test vehicles fired from U.S.S. "Norton Sound" in the South Atlantic

Martin missile training (2): practice firing, from a standard 2½-ton U.S. Army truck, of a Lacrosse field artillery missile. Controlled in flight from a forward guidance station, Lacrosse missiles are equipped to deliver a variety of warheads and are used for all-weather support



DART-POWERED EXECUTIVE

AN AMERICAN STUDIES THE GRUMMAN GULFSTREAM

WITH nearly 100 Vickers Viscounts now in service with Capital, Northeast and Trans Canada Airlines, there are probably few people along the Eastern coast of the United States who have not yet had occasion to hear the characteristic sound of the Rolls-Royce Dart engine. Plying their trade between Montreal and Miami, the airline Viscounts have made the whine of the Dart turbine a familiar—but by no means displeasing—sound to millions of Americans. The residents of Bethpage, Long Island, a small community some 27 miles east of New York City's Times Square, also have been hearing Rolls turboprops in recent days, but with a regularity far beyond that which could be accounted for by any stray airliner. Emanating from nearby Grumman Aircraft, the engine sounds they have been hearing have been generated by the twin RDa.7 Darts installed on prototypes of an aeroplane called the Gulfstream.

Product of Grumman's main facility at Bethpage, the Gulfstream is a pressurized 350 m.p.h. business aeroplane. Some brief comments on the aircraft were published in *Flight* shortly after the first Gulfstream made its initial flight on August 14 last year, but since that time much progress has been made in the development, test and production programmes. Three Gulfstreams are now flying. Ten more are in various stages of assembly, and it is expected that a total of 27 aircraft will be completed by year's end.

That the Rolls-Royce organization will derive substantial revenue from the export of so many Dart engines is, of course, of very great interest to them and to Britain as a whole. And for this reason alone a detailed review of the aircraft is warranted. Another reason for examining the Gulfstream, however, is that the aeroplane has been viewed by some—albeit remotely—as a prospective candidate for the DC-3 replacement market. It may seem strange that the aircraft has been considered in this connection, because the Gulfstream is invariably described as a "ten-place business aeroplane"; but this description does not reveal the fact that the Gulfstream is a DC-3 size aeroplane which was specifically designed to replace the many executive DC-3s now in service with corporate fleets. Logically, an aircraft of this type will draw some speculation as to its abilities to perform other DC-3 missions.

Background. The Gulfstream was conceived in the days following the conclusion of the Korean War. Towards the end of that campaign it had become apparent to U.S. airframe manufacturers that an increasing proportion of subsequent defence appropriations would be allocated to guided weapons. Expenditures for manned aircraft would accordingly be reduced as missiles took over many rôles formerly assigned to piloted vehicles. Concurrently it appeared inevitable that electronics and other aircraft systems would require a greater share of the funds spent on aircraft procurement. The net result of these conditions was that the amount of money that a manufacturer could expect to receive in the future from military airframe sales appeared to be gradually diminishing. Faced with this prospect, the manufacturers turned to the civil market as a possible outlet for their wealth of airframe manufacturing talents. The giants of the U.S. aircraft industry made plans for that nation's first generation of turbine airliners during this period. The free world subsequently entered the "jet age" as a result of the conflicting missile *v.* aircraft demands for funds, and the resulting need to have "something in the shop."

Grumman, who had produced large numbers of aircraft for the Navy and Air Force during the war, also foresaw the need for post-war diversification into the civil market. Many of their F9F-series fighters had seen service in the Far East, but it was clear that with the end of the war the F11F Tiger—successor to the F9F—would not enjoy as lengthy a production run as its predecessor. Some additional airframe work was needed to take up the slack left by falling sales of fighter aircraft. A civil project was thus sought to fill the gap until the company could effect the transition to missiles and turn them out in substantial numbers.

To Grumman the civil market was not new. Beginning in 1936, they had produced three models of amphibians which were soon adapted for business and private transport. These were: the G-21 (JRF) Gray Goose, 345 of which were built; the G-44 (J4F) Widgeon, 286 of which were constructed; and the G-73 Mallard. A total of 59 Mallards were assembled before production was discontinued at the start of the Korean War. When these production figures are added to the 56 G-7 (JF)s, the 260 G-15 (J2F) Ducks, and the several hundred G-64 (and JR2F, SA-16 and UF-1) Albatrosses, all amphibians turned out exclusively for the armed forces, a claim can be made that Grumman has manufactured more amphibians than any other aircraft builder.

With this extensive background in water-based aircraft, it was logical that some thought should have been given to producing a new amphibian for the civil market. Some preliminary layouts were made under the corporate designation of G-122 of a small twin-engined amphibian, along the lines of the Goose/Widgeon series. Informal surveys of the market for such an aircraft, however, indicated that prospects for substantial sales were none too promising. The study was dropped.

Other design work of that period included a three-engined medium-range jet transport—the G-130—and an agricultural

aircraft. The former project was dropped after only a few preliminary layouts had been made, but the agricultural aircraft programme subsequently reached fruition in the form of the Grumman G-164 Ag-Cat. But the primary efforts of that time were centred on the design of a turbine-powered business aeroplane. Now called the Gulfstream, this aircraft then bore the company designation of G-159.

Having themselves utilized two corporate DC-3s (plus a Mallard and three Gooses—or Geese) for transport of company personnel, Grumman were aware of a growing demand for a turbine-powered DC-3 replacement, tailored to meet the needs of the travelling businessman. Owners and former owners of Grumman aeroplanes also inquired about a new business aircraft. There was some debate in aircraft circles about the type of powerplant most suited to business operations. Should turbojet or turboprop engines be used? Grumman selected turboprops for the G-159 for two main reasons: (1) because the projected aircraft was to be in full production in 1959, and no suitable turbojet appeared in prospect for that time scale; and (2) there was doubt as to whether or not the business world would be ready to receive turbojet business aircraft until the turbojet airliners had seen several years of service.

Both the T53 and T55 turboprops were considered for a time, as well as the Dart; but the British engine had a number of major factors in its favour, and these led to its ultimate selection. The Dart fitted the desired horsepower requirement, and was beyond question a proven engine with a growing reputation for dependability. It also had the support of the world-wide Rolls-Royce service organization. Another prime consideration was that the Dart was not at the end of its development cycle. Future growth versions of the Gulfstream could be evolved simultaneously with later, more powerful marks of the engine .

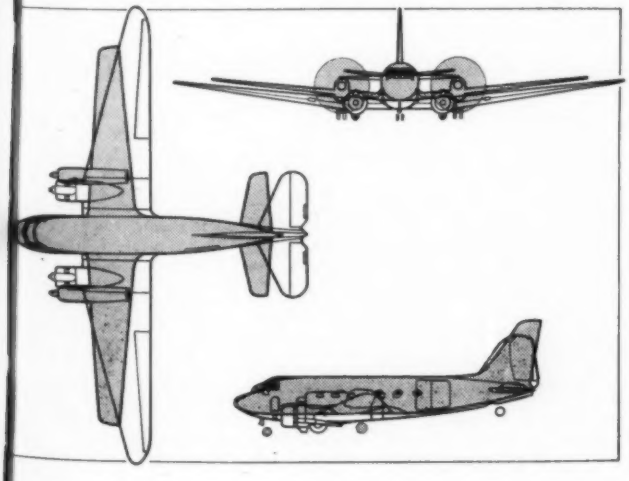
The G-159 project was originally concerned with stretching the TF-1 Trader aircraft, the piston-powered, carrier-based transport version of the S2F anti-submarine aeroplane. The intention was to utilize as much existing hardware as possible, thereby holding development and production costs to a minimum. Layouts were made of a Dart-powered TF late in 1956, but the aeroplane lacked the features and growth potential necessary to make it attractive to the business customer. The TF/S2F wing had been designed for high-endurance, low-altitude flight. These considerations all but ruled out the possibility of obtaining a 350 m.p.h. aeroplane; this speed was held to be the minimum acceptable value. Further preliminary design work was directed towards the evolution of a wholly new aeroplane.

A market survey was undertaken to assist in establishing the aircraft's configuration, and to obtain needed information about business aircraft operations. *Flight* for November 8, 1957, presented "releasable" details of the survey, which gave substantial support to the proponents of a twin-engined, low-wing aeroplane with stand-up head-room, a cruise speed of 350 m.p.h., and a range of 1,800-2,200 statute miles (no reserves). Management go-ahead for the programme was given in the spring of 1957. Mr. B. J. Harriman, a former project engineer on the F11F, was designated project engineer on Design 159. At the height of the design work load, 250 engineers were assigned to the project.

Manufacturer's Aims. From the outset of the Gulfstream programme, safety precautions have been a prime consideration. The aeroplane has no fewer than four over-wing removable cabin windows for emergency escape. Egress can also be accomplished through the main door (forward), the baggage compartment door (aft), and through an overhead ditching hatch in the cabin roof. Thus a total of seven possible routes of escape exist for the normal complement of two crew-members and ten passengers. Even with a high-density seating arrangement of 21, the number of people per exit is still well below accepted airline minimums. Contrast this figure with some of the new airline turbojets, and one can obtain an impression of the extraordinary lengths to which Grumman have gone to ensure the safety of the aeroplane's occupants.

The Gulfstream's hydraulically operated air stairs. Similarly operated are the flaps, landing gear, brakes, windshield wipers, nosewheel steering and propeller brake. System pressure is only 1,500 lb/sq in

A three-view general-arrangement drawing of the Gulfstream superimposed on one of the Douglas DC-3. Note relative fuselage sizes



Another feature of the Gulfstream is that, although the U.S. Government does not require executive transports to be certified under CAR 4b—the civil air regulation to which all transports that carry fare-paying passengers must be designed—Grumman have undertaken a CAR 4b certification programme. When certified, the Gulfstream can be used for the transport of paying passengers. The company also elected to subject a fuselage to pressurization tests in a water tank. To date, the test specimen has been pressure/fatigue tested to the equivalent of 44,000 hours of flight time, where one pressure cycle is assumed to consist of 1½ hours of flight.

Prominent design features include an integral, powered folding stairs, a self-contained auxiliary power unit for self-starting and ground air conditioning, and a fixed rotating beacon light on the underside of production aircraft.

But unfortunately certification programmes, tank tests, emergency exits, retractable beacons and the like cannot be granted without passing along to the customer his fair share of the costs for these items. Production Gulfstreams are priced at $845,000, a figure which does not include interior furnishings or electronics. This sales price is somewhat higher than those of other aircraft which are competing with the Gulfstream for the executive heavy-twin market. And whether or not the inclusion of the aforementioned features in the Gulfstream will prove to be a sounder design policy than building a less refined aircraft for a lower price is a question which will not be answered for some time. Nevertheless the Gulfstream has attracted much buyer interest.

Airframe. The fuselage is constructed in three main sections. Production breaks exist aft of the cockpit bulkhead and aft of the rear pressure dome. Of semi-monocoque construction, the body uses skin, stringer and circumferential ring combinations. The pressurized area extends from the bulkhead forward of the flight station to the after dome. Designed to withstand a limit differential pressure of 7.2 lb/sq in (based on 6.55 lb/sq in working pressure plus a tolerance for the pressure relief valve), the Gulfstream can maintain sea-level cabin pressure at 15,000ft. Each fuselage is pressure-checked prior to delivery to ensure that the leakage rate, exclusive of venturis, is equal to or less than 156 standard cu ft/min at a differential pressure of 6.55 lb/sq in.

Cabin windows are eliptical in shape, and are identical in dimensions (19 × 26in) to Viscount windows. But whereas the elipse's major axis is vertical in the Viscount, this axis is horizontal in the Gulfstream. One-piece, forged aluminium frames are used to support the windows, each of which is constructed of two Plexiglas panes of equal thickness.

Of circular cross-section, the fuselage has an outside diameter

DART-POWERED EXECUTIVE . . .

of 94in. Stand-up headroom of 6ft 1in is provided throughout the length of the 33ft-long cabin.

Aluminium honeycomb (sandwich) construction is used in the cabin flooring. Several sections of the floor are removable for access. The flooring is supported by a system of fixed rails, which also provide mounting points for cabin furniture. To prevent dirt and dust from filtering into the space beneath the floor, the floor assembly and sidewall liners are sealed.

A variety of custom interiors can be offered, but a more modest "typical ten-seat arrangement" depicted in Grumman brochures shows five rows of two-abreast seats. Each seat has its own adjacent window. A radio rack, galley and coat storage area are located forward. The baggage compartment is positioned aft of the galley at the rear of the aeroplane, within the pressurized area.

Operated hydraulically, the main cabin door supports a self-contained stairway. It can be operated manually in the event of hydraulic failure.

The wings, of all-metal, fully cantilevered construction, consist of a centre section and outer panels. Wing tips are detachable. Nacelles and main landing gear are attached to the centre section, which also includes the integral fuel tanks. The water/methanol supply is contained within rubber fuel-type cells in the outer panels, which also support the ailerons.

Basically, the wing structure is a box beam, with upper and lower surfaces of machined, integrally stiffened aluminium alloy. These "planks"—four to each upper and lower surface—are machined at Grumman from aluminium billets. Tapering in thickness from ¼in at the root to ⅛in at the tip, the finished wing skins also include integrally stiffened supports for spanwise ribs. Wing leading-edges are removable and incorporate inflatable chordwise pneumatic boots for de-icing. The boots are cycled in a spanwise sequence to remove accumulated ice; when they are not being used they are held flush against the leading edge by means of a vacuum system. They are inflated by engine bleed air manifolded in such a manner that they can be operated even during single engine flight. When operated in heavy icing each boot is cycled once every 60 sec; in light icing the rate is reduced to one cycle every 240 sec.

Each of the Fowler-type flaps is supported by four steel tracks. The flaps—single-piece units which extend over 57 per cent span—are synchronized mechanically. Two mechanical drives per side, powered by a single hydraulic motor in the wing centre-section, operate the flaps.

Retracting forward into the engine nacelles, the main legs are also hydraulically actuated. In the event of a hydraulic system failure the mainwheels can be extended by gravity-fall, an emergency air bottle releasing the up-lock. The nose-leg can be blown down with an air bottle should its hydraulic system fail. Extension is permissible at any speed, so that an effective speed brake is available to the pilot. A warning horn will sound if both throttles are retarded with any gear not "down and locked." The main legs have been designed so that in the event of a gear-up landing the gear doors will tear away and the aircraft will skate along the ground on the retracted wheels. Free to rotate in the "up" position, the wheels are capable of supporting tthe Gulfstream's entire weight, so that in a wheels-up landing the underside of the fuselage need not touch the ground.

The mainwheels—two per leg—are made of cast magnesium, using "split type" construction. Tubeless, 7.50-14 12-ply Rating Type III tyres are used, and the dual nosewheels are of similar construction, 6.50-8 six-ply tubeless tyres. The nose gear retracts aft. Single-disc hydraulic brakes with organic linings and automatic wear adjustment are installed. Non-skid brakes will be standard.

Aluminium alloy is the basic nacelle material, but titanium, ordinary and stainless steel are employed in several places for strength and fire resistance. The main-gear doors are affixed to the nacelles and are fabricated in four separate sections. The forward clam-shell doors on the main gear are of the cycling type; they reclose after the gear is extended to insure aerodynamic cleanliness. Nose-gear doors are also of the cycling type.

The tail group and all control surfaces are of conventional aluminium alloy construction. They also are equipped with de-icing boots.

Flight Deck. The cockpit windshield and direct vision windows are made of electrically-heated laminated NESA-type anti-icing glass. Customers may also select electrically-heated "defogging-type" side windows as an optional item. Hydraulically operated windshield wipers are installed. Adjustable fore and aft, the crew seats have hinged arm-rests to facilitate entry. Inertia reels and shoulder harnesses are optional equipment.

All flight instruments, radio and other equipment controls are installed in accordance with latest American design practice. The instruments and system controls are grouped in five main locations: the main instrument panels; the overhead console panels; a centre pedestal; side console panels; and the radio control panels.

Dual control-wheel columns, rubber pedals and elevator trim control wheels are provided for the pilot and co-pilot. Dual landing-gear controls are also standard, and the Gulfstream can be piloted from either seat.

Control Systems. The aerodynamic control system is entirely manual. Operated through a system of pushrods, bellcranks and cables, the ailerons are each equipped with a spring tab (trim tab on the left aileron) to reduce the forces required for displacement.

Trim tabs are installed on both elevators. The rudder pedals are connected to a torque tube which feeds a single rudder control system, and a combination spring/trim tab is incorporated to provide adjustable rudder forces. Spring-tab input is available in any of the flaps-down settings, according to Grumman. The spring tab is "shifted out" when the flaps are retracted.

Mechanical gust-locks capable of withstanding 60 kt gusts are provided on the ailerons, elevators and rudder. All gust locks are cockpit controlled. As a safety feature, a mechanical interlock system prevents both engines from being simultaneously run up to full power with the gust locks activated. The interlock thus prevents take-off with the locks inadvertently in place.

Powerplant. The Gulfstream is equipped with twin Rolls-Royce Dart Mk 529 RDa.7/2 engines, which provide 2,105 e.h.p. (1,900 s.h.p.) at 15,000 r.p.m. Jet thrust and s.f.c. are 505 lb and 0.735 lb/s.h.p./hr respectively. The engine, mountings, accessories, oil system and propeller constitute a demountable powerplant assembly. Forward of the firewall the engine and cowling are identical to Vickers' installation on RDa.7-powered Viscounts. The cowling can be "peeled" rearward to expose the entire engine for maintenance.

Compressor bleed air is used for operation of de-icing boots and door seals. Supplied by Rotol, the four-bladed propellers are 11.5ft in diameter. Propeller anti-icing is accomplished electrically and a propeller brake is provided on the port (main cabin door) side of the aeroplane.

A typical 12-seat Gulfstream cabin arrangement

Fuel System. Each of the two integral fuel tanks contains 775 U.S. (645 Imp.) gal. The tanks are filled through flush overwing receptacles. Kerosine (JP-1) has been used to date in all tests and is being recommended. Independent fuel systems feed each engine, although a cross-flow line permits the pilot to feed an engine from the tank in the opposite wing. Electrical fuel system boost pumps are used to feed the engine-driven high-pressure fuel pumps. At high ambient temperatures a water/methanol system can be utilized to restore take-off power.

The oil tanks, an integral part of each engine, hold approximately 30 U.S. pints. In addition, 11.4 pt of oil are circulated by the pressure pump for engine lubrication. The same quantity of oil is isolated from the pressure pump by a stand-pipe to ensure that an adequate supply is available for propeller feathering.

Fire Extinguishing. A two-shot system is standard. Each nacelle contains a bottle of approximately 7 lb of bromotrifluoromethane, a non-toxic extinguishant. Both bottles can be discharged into either engine.

Hydraulic System. A 1,500 lb/sq in hydraulic system is provided, pressure being supplied by two variable-volume, engine-driven pumps. Wing flaps, landing gear, wheel brakes, door and stairway, windshield wipers, nosewheel steering and the propeller brake are hydraulically operated. In case of emergency, the wing flaps may be operated by use of the auxiliary electric motor-driven pump in the nosewheel well. The hydraulic reservoir is located in the cabin in an easily accessible compartment on the port side of the aircraft aft of the main entrance. In addition to the normal brake system, there is a "normal emergency" system which can be put into operation by switching on the auxiliary hydraulic pump. Should both "normal" systems fail to respond, the brakes can be applied by means of the emergency/parking brake through an accumulator pressure system.

Electrical System. The electrical system furnishes both A.C. and D.C. power. It includes four systems, primary, secondary, stand-by and auxiliary. In the primary system, engine-driven generators, connected in parallel, are employed to supply D.C. power. Either generator is capable of "indefinitely" carrying the

High, wide and handsome: a Gulfstream on test. The Day-Glo paint shows up as white

major electrical loads in the event of an engine failure. The generators are described as being of the "wide-speed range, 300 amp, 28-volt types, specifically designed for 8,000 r.p.m. operation."

The secondary system is the A.C. power system, composed of two 1,500 VA inverters, powered by the D.C. generators. Each engine gearbox drives one of the inverters.

Two 24-volt nickel-cadmium storage batteries, located one in each nacelle, comprise the stand-by system.

The auxiliary power system consists of two A.C. alternators driven by the engine accessory gearbox. The alternators, of the three-phase, variable-speed type, supply power to the propeller blade and spinner, the engine air intake and the electrical windshield anti-icing systems.

Two electrically retractable 600 Watt sealed-beam landing lights are used. Anti-collision lights are provided on the leading edge of the fin cap, in the tailcone, and in the bottom of the fuselage. Wing inspection lights are installed to facilitate inspection of the leading edges. Also standard is a receptacle on the nosegear to which can be attached a telephone for intercom communications between ground and flight crews. The port nacelle contains a receptacle for an external (D.C.) power supply, which can be used for engine starting if the self-contained starting system is inoperative.

Three inverters, labelled "A," "B," and "E," units are utilized. "A" supplies all fixed frequency power requirements except for radar. "B" is a stand-by. "E," a small emergency unit, supplies essential instruments in case the other two inverters are inoperative. A fourth ("C") inverter is supplied as optional equipment and is used to power the radar.

Although available only as optional items, several electronic equipments have been installed in the prototypes and have been approved by the C.A.A. These include: dual V.H.F. communications; dual A.D.F.; dual V.H.F. navigation; dual glide slope receiver; marker beacon; intercommunication; and weather radar. The second aircraft contains an X-band radar. In production aeroplanes, provision is made for installing an HF transceiver, the DME section of VOR/TAC, and an ATC transponder.

Pressurization is maintained by an engine-driven supercharger mounted in the starboard nacelle. The supercharger is a positive-displacement Roots-type compressor. An auxiliary power unit is located in the tail of the aeroplane, and can be used as an alternate source of air. The A.P.U. is a gas turbine compressor which is run off the main fuel supply. Fully enclosed, it has fire-detection devices and a one-shot extinguishing system. Up to 50 amp of D.C. power can be derived from the A.P.U.

Cooling is accomplished by means of a "bootstrap" air cycle system employing water separation to reduce humidity. In the event of cooling-equipment failure the aeroplane can be ventilated with ram air.

Flight Development. First flight of the Gulfstream took place on August 14, 1958. A second prototype made its initial flight on November 11, while the third aeroplane, after being delayed by a strike at Pittsburgh Plate Glass Co., first took to the air on February 17, 1959. A total of more than 300 flight hours have been recorded at the time of writing, and it is expected that certification will be obtained by April 15. Customer demonstration flights have been held to a minimum so as not to delay flight tests. To speed certification, the first aeroplane has been flown to Stewart Field, Florida, where Grumman maintain a staff for year-round testing under near ideal weather conditions. No. 2 aeroplane has also been to Florida, and to Wright Field, Ohio, for in-flight icing tests. Up to three inches of ice are reported to have been accumulated on the aircraft during these tests.

Present plans call for Grumman to retain title to two, and possibly three, aeroplanes. Customer machines will follow, the first going to Sinclair Oil Company.

Marketing Prospects. That a market exists for a "million dollar" (fully equipped price with custom electronics and interior), ten-place business aeroplane may seem strange to the average reader until it is realized that in America no fewer than 1,000 large multi-engine aircraft are now being used for corporate transportation. As noted in *Flight's* special "Business and Touring Aircraft" number (October 10, 1958) most of these aeroplanes are of World War II vintage. It is not unreasonable to expect, therefore, that a number of DC-3 operators will eventually re-equip with a modern turbine-powered executive aeroplane. If even one-fourth of corporate large-aircraft operators purchase a turbine business aeroplane, a substantial opportunity exists for the manufacturers of DC-3 replacements.

Now being offered to the business operator in direct competition with the Grumman Gulfstream are several turboprop and turbojet aircraft. These are: the turbojet-powered Lockheed Jetstar; the turbojet-powered McDonnell M-119; the RDa.7/2-powered Fairchild F-27 Friendship; and the turbine-powered Convair conversions (the Canadair 540, Eland-powered aeroplane is another candidate). Of these aeroplanes, only the Gulfstream has been specifically tailored to the needs of the business operators; and Grumman are hoping that this consideration will weigh heavily in the customer's mind. On the debit side of this argument is the fact that, by enjoying airline and military sales, the other manufacturers are in a better position to offer a lower sales price.

To date, 27 firm orders have been reported by Grumman. Sales of the aircraft are under the direction of Mr. Henry Schiebel, commercial sales manager. Gulfstreams are not delivered directly by Grumman, however; this is the responsibility of four distributors (Atlantic Aviation of Delaware, Pacific Airmotive of California, Southwest Airmotive of Texas, and Timmins of Canada). Grumman furnish the distributor with a completed aeroplane, less interiors and custom electronics. It is then the responsibility of the distributor to equip and deliver the aircraft in accordance with the customer's detailed specifications.

The Future. Grumman policy at the present time is to concentrate on the business market. Primary sales efforts are being directed along these lines; however, some feeder-line and military interest has been evoked.

The Gulfstream has been designed such that full use can be made of growth versions of the Dart engine. The airframe is capable of accepting the RDa.10 with but few changes. It is reasonable to expect that even higher-powered engines could be installed in the future, with corresponding increases in performance and payload-carrying ability. Grumman have considerable experience in "stretching" aeroplanes and it would be surprising if this had not already been considered by them.

The possibility thus exists that the Gulfstream will eventually see uses other than that for which it was originally intended. If so, there will be an interesting reversal of the trends of the past. Heretofore, the large business aeroplane field has been dominated by aircraft designed for the airlines and the military. It would be to the lasting credit of the executive field (and also an indication of its maturity) if an aircraft tailored to their requirements was adopted for other uses.

D. E. A.

LEADING DATA

Dimensions. Overall length, 64ft. *Wing* (area 610.3 sq ft); span, 78.33ft; root chord (at aircraft C/L) 134in; incidence, 0 deg; dihedral, 6.5 deg; aspect ratio, 10. *Tail* (area 136 sq ft); horizontal span, 306in; chord, 64.25in; incidence, 0 deg; dihedral, 6.5 deg; aspect ratio, 4.81. *Vertical Fin* (area 117.1 sq ft); height from ground 22.84ft.

Certification Strength Requirements. Basic flight design gross weight, 33,600 lb; basic design landing gross weight, 32,000 lb; positive manoeuvre limit load-factor, 2.5g; limit sinking speed, 10 ft/sec.

Weights. Weight empty, 20,276 lb; max. fuel load, 10,400 lb; landing weight (with 1,450 lb fuel reserve), 23,950 lb; take-off gross weight, 32,500 lb.

Estimated Performance. Cruising T.A.S. at 25,000ft with 14,000 r.p.m. at 26,000 lb, 350 m.p.h.; max. range at 25,000ft with 10,400 lb fuel and initial take-off weight of 32,500 lb (including 500 lb fuel reserve), 2,460 st. miles; C.A.A. take-off field length at sea level at 32,500 lb, 3,850ft; C.A.A. landing field length at sea level at 30,900 lb, 3,850 ft. Limit speeds: M_D=0.675 above 15,200ft; V_D=341.5 kt C.A.S. below 15,000ft.

Four-engined Goose: the McKinnon conversion of the Grumman Goose, powered by 340 h.p. Lycomings, is pictured here with Mount Hood, Oregon, as a background. The restyled cabin incorporates picture windows, and the price of the machine is $295,000

Sport and Business

FLYING FROM HOUSTON, TEXAS on March 19 in a Mooney Mk 20, William Mullen failed in an attempt to set up a new distance record for light aircraft. He had intended to aim for Rome, a distance of 5,698 miles, and, if no snag had developed, to fly on to Athens or Cairo in an endeavour to beat the 6,856-mile record set up by Pat Boling last year from Manila to Pendleton, Oregon. Mullen's first attempt failed earlier last month when icing forced him to land near Bristol, Tennessee, after taking off from Longbeach, California, for Rome. His second attempt, from Houston, ended at the Royal Naval Air Station at Yeovilton, where he landed on March 20 after experiencing fuel difficulties. Mullen took off for Paris on March 22.

NEW AND USED AIRCRAFT for sale will be on view at the Shackleton Sales Weekend at Kidlington Airport, Oxford, from 11 a.m. to 6 p.m. on April 24, 25 and 26. Demonstration flights will not be a major feature on this occasion. New models by Beech, Cessna, Piper and various German and Italian companies will be included. Further inquiries concerning this event should go to the organizers, W. S. Shackleton Ltd., 175 Piccadilly, London, W.1.

FOLLOWING 50 trouble-free hours of flight testing by SFERMA, the first Beech PD.18S powered by two Turboméca Bastans has been handed over to Compagnie Générale des Turbo Machines at Marignane for a series of tests designed to develop a control system. SFERMA are converting a second Beech D.18S at Mérignac and will include greater fuel tankage. Beech in America are also converting a D.18S as a demonstrator and in order to obtain an American C. of A.

A BENSEN GYRO-GLIDER is to be used by a Midlands engineer in a test-flying programme intended to lead to the development of an inexpensive personal autogyro. The owner of the Gyro-glider, which was imported from the U.S.A., is Mr. H. J. Barnes of Tividale, Staffs, whose daughter Diane spent some months at the Bensen plant at Raleigh, North Carolina, learning to fly machines of this type. Following towed flights with the machine, Mr. Barnes plans to fit a British motorcycle engine to it, and to follow powered flight-tests with the development of a more advanced autogyro which could carry two or three people.

SPORTING AVIATION in Poland during 1958 produced totals of 43,996 hours' powered flying and 40,944 hours' gliding and soaring. Parachute jumps numbered 80,617 from towers and 12,305 from aircraft, and international gliding badges gained included 196 Silver Cs, 23 Gold Cs and one Diamond badge (in addition to 55 Diamond legs for goal flights, three for distance, and nine for height).

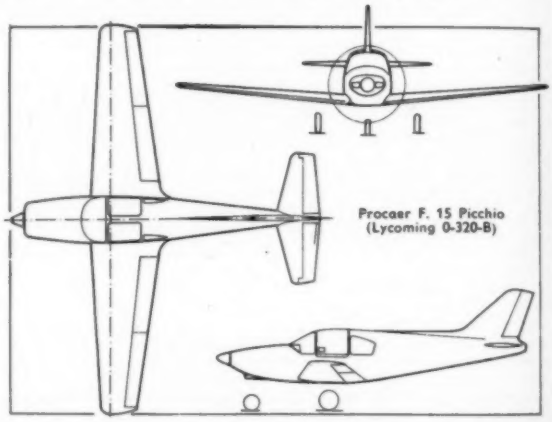
PRELIMINARY TESTS leading towards Federal Aviation Agency certification of the Lockheed Jetstar executive and military 10-seater will begin this year. This was announced by Mr. C. L. Johnson, a Lockheed vice-president, at an I.A.S. meeting in Atlanta, Georgia, recently. Certification tests, he said, will be completed in 1960.

Other news of Jetstar progress was given by chief engineering test pilot Leo J. Sullivan of Lockheed's Georgia Division to the Society of Automotive Engineers in New York. One prototype had flown into 49 airports in the U.S.A. and Canada during engineering evaluation flights, he said; the second prototype had been tested by Air Force and company pilots; and the two machines had logged a total of over 728 flying hours.

LATEST ITALIAN SPORTS AIRCRAFT to be announced is the Procaer F.15 Picchio, which should make its first flight this month or next. It follows the classic tradition established by Stelio Frati, who was responsible for the Falco and Nibbio and is now designing the jet-powered Cobra. The Procaer company is based at Milan.

The Picchio is to be a three-seater with dual controls. Power will be provided by a Lycoming O-320-B giving 160 h.p. and 37 gal of fuel will allow an endurance of five hours. Maximum and cruising speeds will be respectively 187 and 168 m.p.h. Starter and generator will be fitted so that radio and other equipment may be carried. The nosewheel undercarriage is electrically retracted and the nosewheel, when extended, is connected to the rudder pedals for control on the ground. Hydraulic brakes on the main wheels will be operated together by a single pedal. Wing loading and power loading are respectively 16 lb/sq ft and 13.8 lb/h.p. Empty and gross weights are respectively 1,350 lb and 2,200 lb, and minimum speed with flaps down is 53 m.p.h.

The general layout is that of a conventional low-wing, stressed skin airframe with a sharply swept fin, the basic material being wood suitably treated to resist damp and heat. The skinning is unconventional in that a plywood skin is covered with aluminium sheet glued with Aerolite. This produces a rigid, smooth, durable and easily repaired surface which is stated to offer strong resistance to adverse climatic conditions. Rigidity and clean finish are important because a NACA 640 series laminar-flow aerofoil is used. The metal skin need not be periodically repainted.



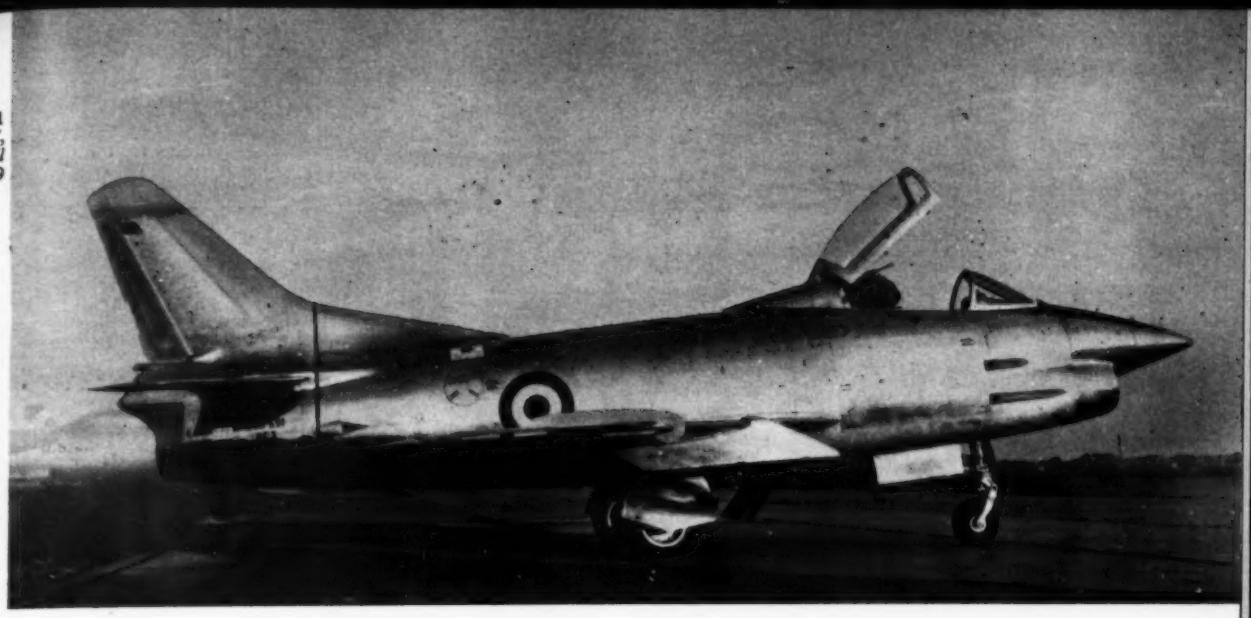
KENT GLIDING CLUB members made their final flights from Detling Aerodrome on Sunday, March 15. A spokesman for the club said that the Air Ministry recently re-sold the land to the pre-war tenants and that the new owners had told the club that they did not wish any more flying to be undertaken from the airfield. The temporary use of Lympne has been offered until the club finds a new permanent site.

THE ANNUAL RALLY of the Aero Club of East Africa, held on March 1 at Wilson Airport, Nairobi, attracted more than 2,000 spectators. Among the events was the East African Aerial Derby for the *East African Standard* Challenge Cup, won by J. B. Wood, chief pilot of Airspray (E.A.) Ltd., in a Boeing Stearman; and a road-landing contest for the Grafton Rose Bowl, won by Keith Campling.

RETROSPECT

From "Flight" of April 3, 1909

M. Faure is Unfortunate: Upon his first attempt at flight at Monaco with his rebuilt Malecot dirigible balloon, M. Jacques Faure had a somewhat unpleasant experience. After making three circuits of the bay, M. Faure endeavoured to pass over the Oceanographical Museum, which stands on the rocks, without loss of ballast, simply by manipulating the planes and accelerating the engine. The propeller, however, struck the roof of the Museum and the machine was rendered unmanageable. The mechanicien, Andre, stopped the engine and then, on the advice of M. Faure, jumped into the sea, where he was picked up by a motor boat. M. Faure remained on his airship, and was afterwards towed ashore, little the worse for the *contre-temps*, and throughout the incident he displayed the utmost presence of mind.



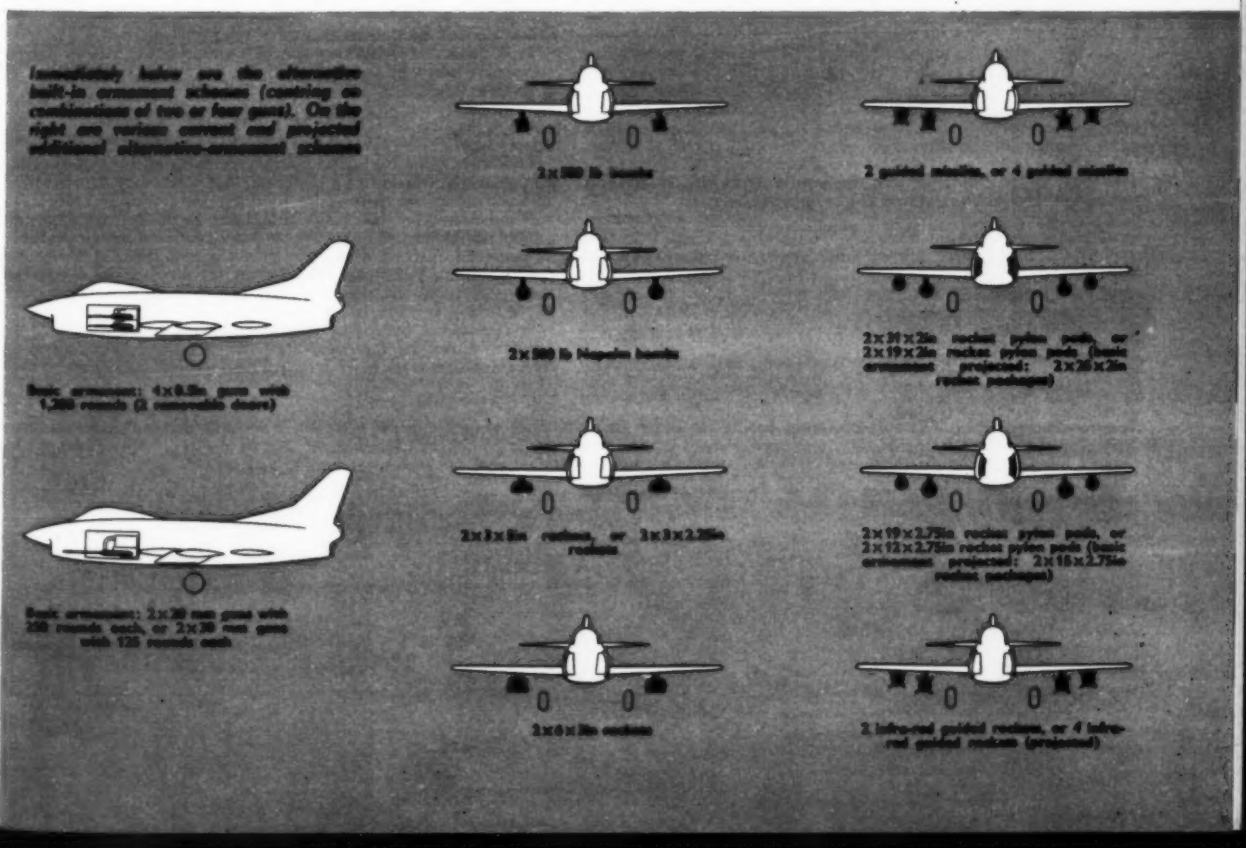
MOBILE AND AGILE: THE FIAT G.91

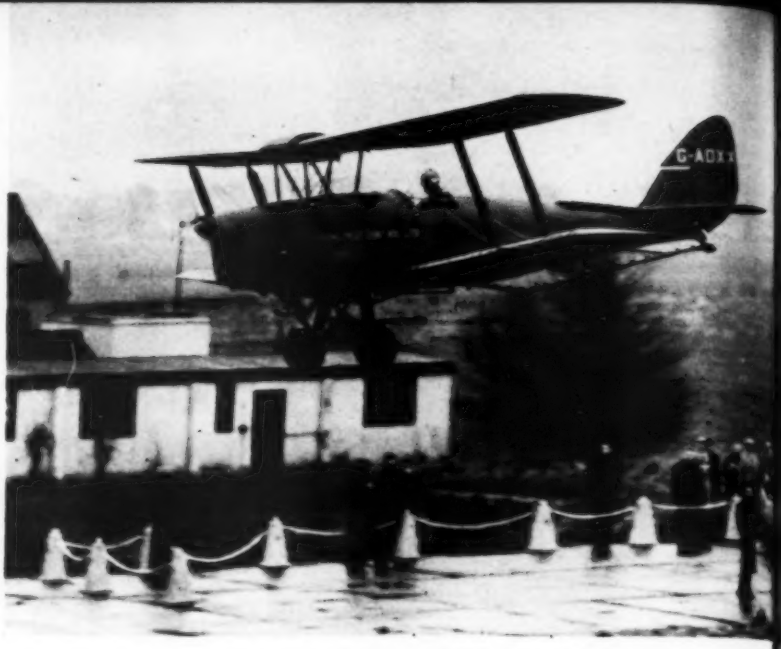
West Germany's and NATO's Choice

ON March 11 two contracts were signed in Bonn between the Bundesministerium für Verteidigung (Defence Ministry) and Fiat; they concerned respectively, the purchase of 50 Fiat G.91Rs (reconnaissance variant of the basic ground-attack type) by the Federal Republic and the purchase of the manufacturing licence for the type. German interest followed selection of the G.91 as NATO's standard light-attack aircraft. All G.91s are Bristol Orpheus-powered.

In announcing the contracts Fiat released additional information on the G.91. They state, for instance, that the possibility of ramp take-off is under study as well as rocket-assisted take-off; and they claim that its small size enables the G.91 to take advantage of surrounding vegetation in addition to more conventional camouflage and to move many miles a night with the help of ordinary tractors and on a normal road network. Fiat add: "A tank-truck, a radio and radar mobile unit, a workshop-truck, in addition to some auxiliary vehicles for the transportation of engines, spare parts and the small team of squadron specialists necessary for the aircraft operation, are sufficient to form a base for the G.91s."

The makers quote the "maximum efficiency operational speed" for ground support operations as between 370 and 435 m.p.h., adding that the aircraft can turn at about 155 m.p.h. and "roll suddenly on a 250 deg/sec basis." Pull-outs involving 7g accelerations are easily performed. They add: "Practically, the main limit to the aircraft's possibilities of operating, manœuvring and strafing is the pilot's ability. At the same time, the aircraft's high stability, improved also by a yaw damper, makes the G.91 an excellent firing platform and provides high-precision hits for its armament."


Immediately below are the alternative built-in armament schemes (centring on combinations of two or four guns). On the right are various current and projected additional alternative-armament schemes
Basic armament: 4×9.8in. guns with 1,200 rounds (2 removable drums)
Basic armament: 2×30 mm guns with 250 rounds each, or 2×30 mm guns with 125 rounds each
2×500 lb bombs
2×500 lb Napalm bombs
2×8×8in rockets, or 3×8×2.25in rockets
2×6×3in rockets
2 guided missiles, or 4 guided missiles
2×38×2in rocket pylon pods, or 2×19×2in rocket pylon pods (basic armament projected: 2×28×2in rocket packages)
2×19×2.75in rocket pylon pods, or 2×12×2.75in rocket pylon pods (basic armament projected: 2×18×2.75in rocket packages)
2 infra-red guided rockets, or 4 infra-red guided rockets (projected)



Sweeping low over a marked-off strip, a modified Tiger Moth demonstrates a spraying technique. It belongs to Agricultural Aviation of Panshanger

FARMING BY AIR

Downham Market Sees "Operation Downwash"

"FLIGHT" PHOTOGRAPHS

IT has taken nearly eleven years of pioneering aerial spraying in Britain for the idea really to catch on, but in the past three years the aeroplane at last seems to have become established as a seasonal agricultural tool. The summers of 1957 and 1958 were more than usually wet, and widespread outbreaks of blight in Great Britain were successfully tackled from the air; it has been said that there would be few home-grown potatoes to eat this year were it not for aerial farming.

Encouraging results have produced a significant increase in spraying activity, and the demand for blight control and other forms of aerial spraying has grown so rapidly in the past two years that the amount of work has trebled. As with all booms following recognition of a technological development there are both those who paint too optimistic a picture of the technique and those who go to the opposite extreme; and both in their ways do harm to the development of agricultural aviation.

To show the economic value and the practicability of spraying from the air, a demonstration of aerial spraying, Operation Downwash, was given at Downham Market Airfield, Norfolk, on March 19 by Fisons Pest Control Ltd. and their associated company Fison-Airwork.

Aerial spraying, as the company has repeatedly emphasized, cannot be done by just rushing an aeroplane up and down a field and shedding whatever chemical is needed; it has got to be done with a good deal more science than that. There are more variables than at first meet the eye, and successful and economical operation requires consideration of most of them. The Downham Market display was intended to show some of the techniques involved in spraying various chemicals by different types of aeroplane—not all of them, incidentally, those operated by Fison-Airwork, as it does not pay one company to try to cover the whole of the short U.K. season (which lasts from about the beginning of July to the end of August) and Fisons sub-contract some of the work.

The various aircraft were set to work spraying or dusting a marked-out patch of the airfield. The grass spraying-strip was sufficiently confined by trees and buildings to demand some special skill from the pilots. A Tiger Moth, an EP.9, a Piper Super Cub and a Chipmunk Mk 23, plus a helicopter—a Hiller 12C—were put through their paces with various types of chemical, and a morning and afternoon programme were run through with commendable despatch.

Because the amount of ground that can be covered in a given time is a primary criterion of economic operation, considerable attention was paid to the time taken to load the various aircraft with solid or liquid chemicals and the periods occupied in turning at the end of each run; some comparative data for the aircraft demonstrated are given in the table on page 466.

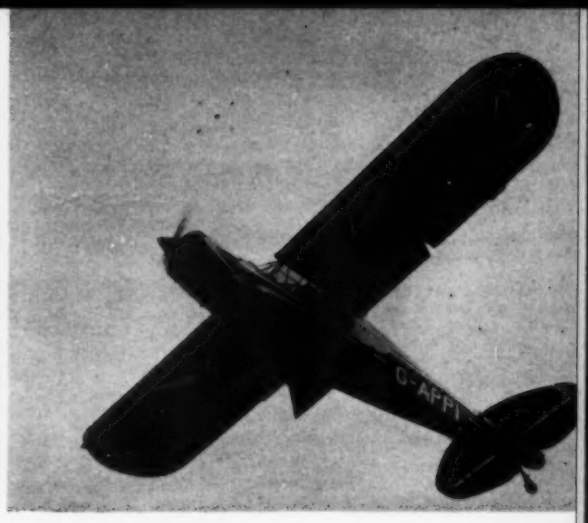
On both counts the helicopter was enormously impressive. As the boundary marker was crossed at the end of each run, the Hiller climbed up to about 50ft and twizzled around almost on its own normal axis before dropping down again for another sweep. The reversal took about nine seconds—a time not approached by the fixed-wing aeroplanes. The Hiller was also noticeable for its remarkable steadiness as an applicator in a cross-wind gusting up to 15 kt, which is 5 kt above that normally considered the maximum for successful spraying.

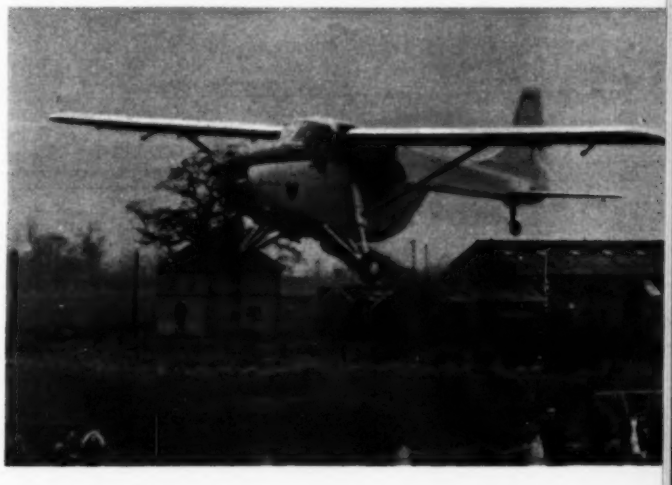
In remarkable contrast to the helicopter was the Tiger Moth, which seemed to suffer from the gustiness and, flying three or four times faster, at first had a little difficulty getting lined up and at the right height after each steeply banked turn. The EP.9 gave an even more sporting demonstration than the Tiger Moth, using its greater power to splendid effect in rushing around in a steep turn —which nevertheless took 25 sec. It all looked good fun, but one could not help remarking that the Hiller—with its Cambridge-blue livery now embellished with Day-Glo—tackled the task in an altogether less boisterous and more scientific manner.

This particular demonstration, it should be added, was over a very small strip of soil, so that the fixed-wing aircraft hardly showed to advantage. Nor could a flying demonstration illustrate the comparative economics of fixed and rotary wings. The latter are well known to be a good deal more expensive to operate. Exact costs depend upon the terrain, the type of machine used, the proximity of a landing strip and the type of chemical to be applied; but, typically, the cost of a helicopter operation may be 53s to 75s an hour compared with 43s to 60s for a fixed-wing aircraft.

Fison-Airwork, who operate altogether 28 Hillers, are achieving annual utilizations of about 660 hr, but up to 1,000 hr can probably be achieved on certain types of operation. Banana spraying, for example—a task the company are undertaking in the Caribbean area—is a round-the-year job, with the fertile banana trees requiring spraying at intervals of perhaps only 15 days. That 1,000 hr is a reasonable helicopter target is illustrated by the 1,050 hr annually flown by the company's five Westland Whirlwinds on oil-exploration work in Nigeria. These aircraft could also be used

Farm-equipment detail. The 34ft-long spray bars of the Hiller 12C (left) have 34 nozzles giving a total flow of 15-20 gal/min; tanks are slung each side of the Franklin engine. Modified since it appeared at Farnborough last year, the Chipmunk Mk 23 uses a windmill-driven spray pump. On-site topping up of the helicopter with chemical (right) while the engine was running took only 45 sec





The photographs above and right provide a comparison of agricultural aircraft in British use. Above, this air-to-air shot shows a Hiller in action over a field, while right, top to bottom, are a Piper Super Cub equipped for fertilizer spreading, a Chipmunk spraying from very low down, an EP.9 spreading fertilizer from its 1,500 lb capacity hopper, and a Westland Whirlwind demonstrating low-speed, low-altitude control

for agricultural work (as shown in the photograph on the right, one appeared as an "extra turn" in the Downham Market programme) and B.E.A. are in fact offering their Whirlwinds for this purpose although their high operating cost makes them show to disadvantage over smaller, lighter types.

The Piper Super Cub has already established an enviable reputation as an agricultural machine, and with its low wing-loading, reasonable carrying capacity, high wing and low-pressure tyres, it is well suited to the task. A tandem-seat aeroplane is also fairly easy to modify, as the rear seat can be replaced by the hopper. The Mk 23 Chipmunk, on the other hand, is interesting because at first sight a low wing does not appear particularly suitable for an aircraft which must spend so much of its time flying a few feet above the ground. The Chipmunk has been modified by the addition of a raised and strengthened canopy to help overcome this disadvantage, and it is claimed for it that the aircraft keeps particularly clean, especially in the region of the cockpit.

Both machines were effectively demonstrated at Downham Market. The Cub turned at the end of its run in only 17 sec and afterwards flew past with flaps down to show its slow-speed capabilities. The aircraft was fitted with a 7 cwt hopper and a large venturi-type dispenser for spreading fertilizer. The Chipmunk, which was equipped with a windmill-driven centrifugal pump (the installation has been modified since the aircraft was first publicly displayed at Farnborough last year), spray bars and nozzles, sprayed water over the demonstration strip during three very steady runs. Its turning time was 22 sec.

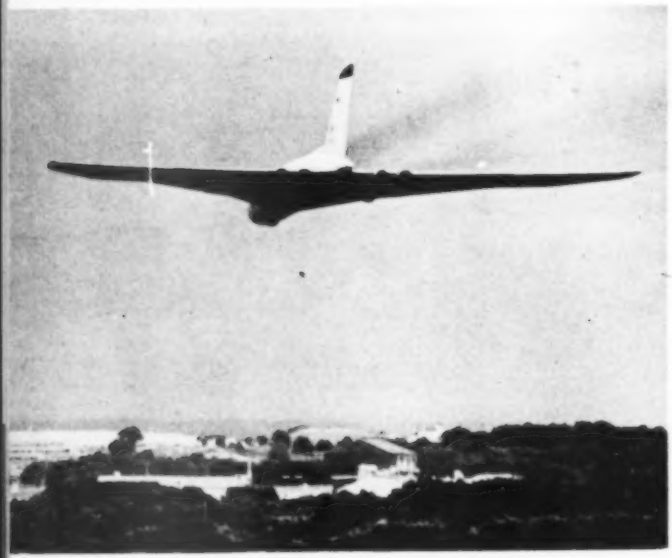
Final runs by the Tiger Moth, EP.9 and Hiller, and a demonstration of manœuvrability by the Whirlwind, completed a rather damp but far from depressing display; a welcome lift in the weather had just prevented Operation Downwash becoming Operation Downpour, but there were never any fears that the poor visibility would keep the aircraft on the ground.

Fison-Airwork are clearly under no illusions that present agricultural techniques—and, indeed, present agricultural aircraft and equipment designs—are at a more than embryonic stage. This does not necessarily mean that there is at the moment a large undeveloped market for new types of aircraft specifically designed for agricultural use; spraying is still most cheaply accomplished by modifying production designs like the Super Cub or obsolete Tiger Moths, because airframe first cost bears heavily on the hourly cost of operation. No one watching the Downham Market demonstration could fail to be impressed by the capabilities of the two helicopters, and many believe that helicopter or VTOL or STOL developments will pave the way for the ideal agricultural machine. It is an immense advantage if a crop-sprayer can land to refuel and be re-loaded on the site, and in some cases this feature alone makes the use of helicopters worthwhile. Associated advantages are that the blade downwash provides better penetration of the spray to the underside of leaves and among tall crops, and that the helicopter can spray closer to trees and hedges. Spray from a helicopter is also less susceptible to wind drift, because height and position can be carefully controlled.

Development is also clearly possible in the realm of spraying gear. Normally, liquid fertilizer is pumped by a centrifugal or gear-type pump (which may be driven either electrically, or more usually by a windmill fan) through spray bars and out through variable-area nozzles. Droplet size can be varied by altering the size of the nozzle, its inclination in relation to the slipstream, or

[*Concluded on page 466*

VULCAN B Mk 2



Character studies of XH533, the first Avro Vulcan B Mk 2 (as distinct from the "aerodynamic prototype" VX777). The engines are Bristol Olympus 200-series of some 17,000 lb thrust apiece. Compared with the B Mk 1, the new Vulcan has a wing of revised planform and section, with extended, cambered leading edges. It is designed to carry the Avro stand-off bomb. The last of the three pictures on the left shows XH533 at the instant of releasing her Irvin braking parachute.

FARMING BY AIR (Continued from page 463)

the pressure-level of the fluid. But with gas-turbine aircraft (the Alouette 3 in the agricultural rôle is highly regarded by Fisons, but the Saunders-Roe P.531 is being studied with interest and even the Rotodyne has been mentioned in an agricultural application) there is a possibility that air bleed could be valved to give very close control of the spray. It might also be used to advantage for spreading fertilizer; the impression gained from the demonstration is that a hopper discharging into a large venturi is a relatively crude and only partially effective way of ensuring an even spread of chemical.

Such possibilities give rise to thoughts of utilizing advanced concepts such as flying platforms, tilt-wings, ducted propellers or lift fans to produce an implement specifically designed for crop-spraying and general agricultural use. It must obviously be robust and simple and require the minimum skill to operate, perhaps to the extent where a farmer could hire a machine and operate it himself. At present, agricultural spraying is offered as a service providing operators, equipment, special chemicals and expert knowledge which can be called upon whenever it is needed. But whatever the technical specification of the new equipment will be, the factor of first cost is going to mitigate against extensive special development. And for this type of flying, where operation is nearly always under quite rough conditions, it will be a considerable time before the unsophisticated fixed-wing aeroplane, cheap to buy and easy to maintain, is superseded by more modern and productive tools.

SOME COMPARATIVE DATA FOR AIRCRAFT AT DOWNHAM MARKET

Aircraft	Spraying					Dusting		
	Hiller 360		Tiger Moth		Auster*	EP.9	Tiger Moth	Piper Super Cub
	Coarse	Fine	Coarse	Fine				
Carrying capacity (lb or gal)	40-50 gal	40-50 gal	60 gal	60 gal	500-600 lb 50-60 gal	1500 lb	600 lb max 448 lb normal	784 lb
Pump or spreading gear	gear	gear	centrifugal (windmill)	centrifugal (windmill)	gear (windmill)	gate drop or venturi	venturi	venturi
On-off gear	electric	electric	mechanical	mechanical	manual	—	—	—
Cruising speed	70	70	70	70	100	115	70	100
Spraying or spreading: speed (m.p.h.) ...	30-45	30-45	70	70	65-75	45-85	70	70
Spraying or spreading: height (ft)	5-12 above crop	5-12 above crop	10-12 above crop	5-10 above crop	8-20 above crop	5-40	15-40	30
Spraying or spreading: swath (ft)	50-60	50-60	40	40	50-60	45	30	30-45
Filling time per load (sec)	60	60	210	210	180	30-60	60	45
Acres covered per load	13-17	13-17	12-15	12-15	17 (at 3 g.p.a.)	4-15	2-4	7
Average acreage covered per hour	50-60	50-60	40	50	40	30-40	15-40	50

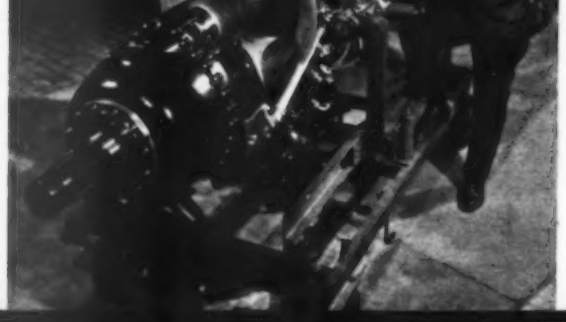
* Figures for the Auster Workmaster were quoted on page 422 of "Flight" last week.

OFF TO SURABAYA

WITH deliveries of the first six Gannets for the Indonesian Navy due to start at the end of this year, the Fairey Aviation Co. Ltd. is to train Indonesian pilots (with the assistance of a Royal Navy instructor) and is also sending out a training mission to Indonesia, headed by a Q.F.I. This mission will be based at Surabaya for approximately 18 months to two years. It is to include specialists in ground trades, and the company has expressed a preference for personnel recently released from the Royal Navy who have Gannet experience.

NEW FROM GENERAL ELECTRIC

First picture of the T64, under development for the U.S. Navy Bureau of Aeronautics by American G.E.'s Small Aircraft Engine Department at Lynn, Mass. Rated at 2,600 h.p., the T64-4 seen here is a free-turbine turboprop; the T64-2 is a turboshaft engine for helicopters using the same power section



MR. L. W. WARNER

WE regret to record that Mr. Leonard William Warner, formerly Director-General of Aircraft Production at the wartime Ministry of Aircraft Production, died on March 20 at the age of 73. His association with aeroplane construction went back fifty years, to the days when he joined Short Brothers in the Isle of Sheppey, working with Horace Short as an experimental engineer; and he was concerned in the design of the engine installation and manufacture of the transmission for the Short No. 2 biplane in which J. T. C. Moore-Brabazon won the £1,000 prize offered by the *Daily Mail* for the first circular mile flown in this country by an all-British aircraft. At the beginning of the First World War he joined the Aircraft Inspection Directorate (later absorbed into the R.F.C. and then the Air Ministry); and thereafter, from 1914 to 1928, he held progressively more important posts until (under Col. Outram) he was responsible for the technical direction and inspection of complete aircraft manufactured at airframe firms throughout this country. In 1929 he was responsible for the inspection and airworthiness of each flight of British aircraft competing in the Schneider Trophy contest; and in 1938 he went to the U.S. to organize inspection of the first contract deliveries of Hudsons and Harvards. Subsequently Mr. Warner left the A.I.D. to become Air Ministry assistant director responsible for production of bomber aircraft; then he went to the M.A.P., becoming its Director-General of Aircraft Production.

SERVICE "AT HOMES"

SEVERAL U.S.A.F. and F.A.A. airfields will be open to the public this summer. The R.A.F. "at home" season does not, of course, occur until Battle of Britain week in September; but it is likely that their aircraft will appear in earlier displays.

Dates when the U.S.A.F. (Third Air Force) bases are open all occur during May, either at the beginning or end of the U.S. Armed Forces' Week. One airfield, Wethersfield (near Braintree, Essex), base of the 20th Tactical Fighter Wing, will be open on May 9; and three others will be "at home" on May 16: Bentwaters (Rendlesham, Woodbridge, Suffolk), 81st Tactical Fighter Wing; Sculthorpe (Fakenham, Norfolk), 47 Bomb Group (Tactical); and Alconbury (near Huntingdon), 7560 Air Base Group.

The Fleet Air Arm airfields are all open during July with one exception, Arbroath, which is "at home" on June 12. The others which can be visited are as follows: Lossiemouth (Morayshire), July 11; Abbotsinch (Paisley), July 11; Brawdy (Haverfordwest, Pembrokeshire), July 18; Yeovilton (near Yeovil, Somerset), July 20; and Culdrose (Helston, Cornwall), July 20. These last two open days, unlike all the others mentioned, occur on a Monday.

Straight and Level

DID you read (in *Flight* last week) that the Kenya Police Air Wing is equipped 100 per cent with American light aeroplanes? And that the Royal Australian Air Force has ordered Cessna 180s for A.O.P. work? And did you hear (any politician or any newspaper for years past) say that though Britain will not allow herself to build supersonic bombers she will have a continuing and pressing need for "police" (more fashionably "fire brigade") aeroplanes for localized overseas actions? And have you heard it suggested that somebody in this country should pull his finger out and build light aircraft acceptable for overseas operation?

Of course you have. And now here you are hearing it again.

Sickening, isn't it?

● The latest person to propose lower fares for slower services is Mr. Arthur Raymond, Douglas senior vice-president. He recently told the American Society of Mechanical Engineers at Los Angeles that depreciated, higher-density DC-6s and DC-7s should be used to develop "cross-country" services within America. If allowed to offer fares well below present levels, these aircraft would, he declared, "attract a substantial new market segment without dilution of the existing market."

Mr. Raymond noted, in passing, that such a plan would assist the trunklines in disposing of their piston fleets.

For the past few years Mr. Raymond has been stressing that the DC-8's seat-mile costs will be lower than those of DC-6s and DC-7s. If that is so, why not sell DC-8s to "cross-country" carriers?

Because, I think, there is nothing so cheap to operate as a depreciated Douglas piston-engined airliner.

● Last week Sir Charles Boost, firebrand boss of Plummet Air Lines, decided to chain himself to the railings outside the Planes Ministry. It was to be his "gesture of dissent and defiance" at Britain's supersonic airliner policy.

Before the chaining-up ceremony Sir Charles called a news conference at his office. "Britain must leapfrog the supersonic airliner," he declared, "otherwise we shall drop our biggest clanger yet. We must steal a march on these Yanks, and show the world the Blue-Riband brilliance of our inventors. The Yanks say they can do a Mach 3 jet airliner by 1970. All right—we'll jolly well do a Mach 7 hypersonic boost-glide rocket airliner by 1969. Just think of the prestige it would bring. We British have the guts and the genius to do it, you know. We could do it tomorrow. Here, read this."

He tossed me a pamphlet entitled *Technical Facts about the Plummet Hypersonic Boost-Glide Rocket Airliner*. It explained how, the faster an airliner flies, the lower the operating cost "because increased ton-miles in the year mean increased economy. . . . The more work in the hour, the more revenue—hence more profit," etc., etc.

Passengers would all be "desensitized" before take-off by being deep-frozen in special gimbal-mounted, alpha-particle canisters. There would be a big overseas market, especially among Commonwealth airlines, who were being kept "fully informed."

"Actually," Sir Charles confided, "that's out of date now. I'm seeing Blackie Blackout-Jones of Scruggs tomorrow to hear about his absolutely super new airliner, which could be ready *one year after the VC.10!* Just think of that! It will be powered by a solar furnace, photon sails, thermonuclear fusion rockets, and ionized-deuterium plasma jets. We've got to keep our ion new developments, eh laddie. . . ?"

● The "swing-tail" back-end of Canadair's CL-44 Tyne-powered Britannia-development is a most audacious piece of engineering. If it works in the rough and tumble of day-to-day ground-loading it will make a 30-ton payload freighter with perfect aft-loading out of a 170-seat, 400 m.p.h. passenger airliner—quite a desirable combination. And it will be available next year.

● Quite the most surprising aspect of the Canadair swing-tail is that its designers claim to have *reduced* by 1,000 lb the empty weight of the CL-44 with side-loading doors.

Spare a thought for the loads on the hinges when all that overhang is subjected to wind velocities of 60 m.p.h. or so when on the ground, and the ingenuity of the engineering is seen in a new perspective.

A lighter solution still would have been to make the tail completely detachable so that it could be wheeled away on a trolley—simpler to engineer (with quick-connect plumbing and wiring, etc.), aerodynamically as good, but much more difficult operationally. So Canadair chose the difficult alternative—and I think they may have pioneered a new fashion.

● When I was down at R.A.F. Tangmere recently my eye was caught by one of Cuthbert Orde's famous R.A.F. Fighter Command portraits hanging in the officers' mess. It showed a handsome and serious-looking young pilot, wearing a polo-necked sweater, and underneath was the caption: "W/C. T. G. Pike, D.F.C., 219 Squadron."

That drawing was made in 1941; and when Air Chief Marshal Sir Thomas Pike's appointment as the next Chief of Air Staff was announced last week I couldn't resist looking back at Orde's original notes about his subject:—

"He is known in the squadron as 'Killer.' I don't think that's a good nickname for him really, as he is much too kind and friendly. . . . He is very much the staff officer and was in the Air Ministry till February 1941. It is a remarkable thing, and typical of his powers of concentration, that he should have become an unusually successful night-fighter in so short a time."

No doubt those same powers of concentration will come in handy from next January 1 onwards.

● An American firm has designed a "space watch." According to an ad. in *Astronautics*, "the watch would not only tell Earth time and date, and time on other planets, but would provide a radar warning system for meteors, a radar speed indicator and a gyroscope to track direction."

Me poor wrist.

● "The wonderful advantages of Jet flight . . . on the Jet-powered Electra. . . . Like all Jet-powered planes it is more restful. . . . It gives Jet speed of 400 miles per hour or more"—*from an American Airlines advertisement about the turboprop Electra.*

ROGER BACON

The de Havilland Enterprise is well known for, among other things, its alphabet. The de Havilland alphabet (from which it is said the Romans copied theirs) is prescribed for everything from writing paper to factory cleansing-vehicles. And even when D.H. workers go a-banner-marching — as they are seen doing here outside Parliament last week — their identity (bottom left banner) is proclaimed in traditional style

Hops and Flights

A Roll Call of Early Powered Take-offs

By CHARLES H. GIBBS-SMITH

M.A.(Harvard), F.R.S.A., F.M.A., Comp.R.Ae.S.

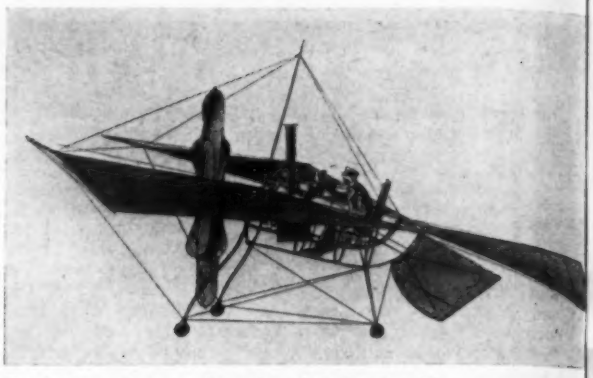


Fig. 1. Approximate configuration of F. Du Temple's man-carrying powered machine, circa 1874

THIS is, we believe, the first time that a comprehensive account of the take-offs—and some failures—of the first powered aeroplanes has been published. It has been contributed by a historian, and results from the research undertaken for his work (to be published in the autumn by the Science Museum), entitled "The Aeroplane: An Historical Survey of its Origins and Development."

IN this article are recorded what I believe to be the most important of the early powered take-offs—along with some interesting claims and one or two myths—which took place from about 1874 up to 1907 in America and on the Continent, and up to 1909 in Britain. Also included is the newly determined first passenger flight in 1908, as well as the results of other new research. The figures cited are the most authentic that can be found. This "roll-call" is revealing in many ways, but it becomes particularly interesting if viewed against the human background of effort, achievement, and lack of achievement.

In view of the fruitful development of petrol engine technology, aerodynamics, and glider pilotage by the close of the 19th century it was to be expected that all the threads would soon be gathered into the hands of someone who would arise and transform the "aeroplane dream" into a practical reality. As everyone knows, this was done by the Wrights, who built their first man-carrying glider in 1900, and by 1905 had achieved a fully practical powered aeroplane which could bank, turn, make circuits and figures-of-eight with ease, and remain in the air for over half an hour at a time. But, once arrived at this point, we are faced with one of the most extraordinary multiple mysteries of technological history. For no other man—or company of men—came even within shouting-distance of the Wrights; and this in spite of the vast resources of technical knowledge, the large amount of published work on aeronautics (including accounts of the Wrights' gliders), personal talent, and enterprise, that then lay in the lap of Europe. It is well-nigh incredible that until November 1907 no individual or group in Europe managed to evolve an aeroplane in which a man could stay in the air for even one single minute. Even more incredible—in the land which invented the modern aeroplane, the land of Cayley, Wenham, Phillips and Pilcher—we could not produce a native-born citizen to build and fly an aeroplane for sixty consecutive seconds until December of 1909. In the light of this fiasco, the death of Percy Pilcher in 1899—on the eve of his powered experiments—appears to us now as certainly the greatest single tragedy in British aeronautical history. But our job here is to write history, not to bemoan it.

The criteria of powered flight must remain to some extent a matter of opinion; but it is a clear indication of misplaced—if understandable—loyalty, or of a lack of historical integrity, to claim as flights those performances which consist of accelerating along the ground and then leaping two or three times the length of a cricket pitch in a matter of two or three seconds. In this connection it is salutary to remember that, in July 1921, near Paris, M. G. Poulain took off and was airborne for 40ft (12.3 m) when riding a pedal cycle equipped with wings—he called it an *aviette*—relying solely on his momentum and the sudden tilting of his wings from the horizontal to an angle of incidence of about 6 deg.

Flight, to be so in any mature sense of the word, must not only be sustained beyond doubt, but controlled beyond doubt. Here the distance through the air (if there is a wind), and the duration of the flight, should always be taken into account. In the later tests —1906 and after—the considerable and rapidly growing body of aeronautical knowledge must also be considered when assessing a claim.

Finally, one cannot overemphasize the fact that it is actual concrete achievement, rather than mere effort—however commendable—that must count in history. In the cases recorded below, the difference between effort and achievement will, I think, be evident enough.

c.1874. Félix Du Temple (French). Charles Dollfus informs me that there is now no doubt that Du Temple, who flew the world's first successful powered model aeroplane about 1857, completed and had tested (with a young sailor as pilot) his patented man-carrying aeroplane (Fig. 1) about the year 1874; that it took off down an inclined ramp at Brest, and was airborne for a short while in what Dollfus calls a "short hop or leap." The machine was powered by a hot-air engine. This is, therefore, the first take-off in history of a powered man-carrying aeroplane, but not solely under its own power.

1882 (July). I. N. Golubev on A. F. Mozhaiski's machine (Russian). Some—but not all—modern Soviet authorities claim that this steam-driven monoplane, with one tractor and two pusher propellers, made a short "flight" of 65-98ft (20-30 m) in July 1882; but even the supporters of the claim agree that the machine was given an accelerated take-off down a "ski-jump" ramp.

1890 (October 9). Clément Ader (French). Ader took off unassisted in his steam-powered *Eole* at Armainvilliers, and was airborne for "about 50 metres" (164ft). This *tentative*, as Ader himself called it, was a "very brief and not a sustained flight," in Charles Dollfus' words; but it is fair to say that it was the first take-off of a powered aeroplane solely under its own power. For the 1897 tests, see below.

1894. Sir Hiram Maxim (British, formerly American). Maxim's huge steam-driven aeroplane was tested at Baldwyns Park, Kent, in 1894, when it ran on rails, with upper guard-rails to confine it should it develop enough lift. With three on board, it did lift itself off the ground rails, but almost immediately fouled and broke the upper guard-rails, and was stopped by its pilot. This has occasionally, and frivolously. been claimed as a flight. A glance at the primitive control-system shows that it was a wise decision not to test the machine in a free take-off. Maxim abandoned this 1894 giant immediately after the crash, and did not build a "proper" aeroplane until his much-heralded machine of 1910: this, however, never left the ground.

1897 (October). Clément Ader (French). With his twin-engine and twin-propeller *Avion III* Ader made two tests, on October 12 and 14, 1897, at Satory, watched by official witnesses of the highest integrity (*vide* the reports). It used often to be said that on October 14 the machine made a few hops, but an examination of the detailed eyewitness reports shows clearly that on neither date did it ever leave the ground for an instant. In a classic and pathetic case of what might be called wishful remembering, Ader later claimed that on October 14 he had flown for 300 m (984ft);

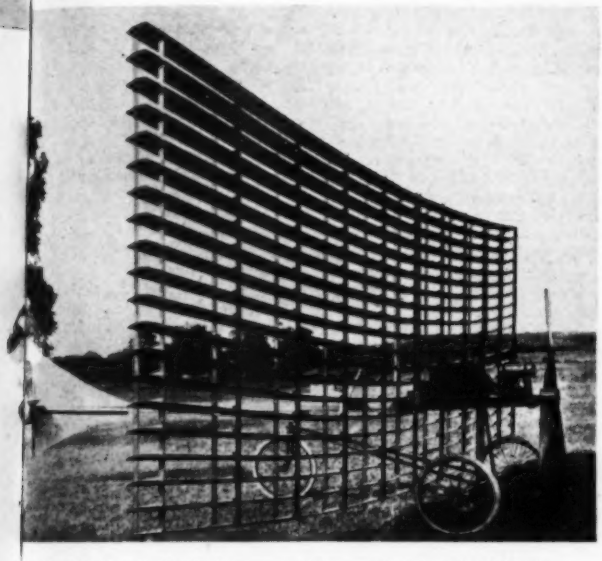
Fig. 2. Karl Jatho's machine of 1903, with which he made powered hops

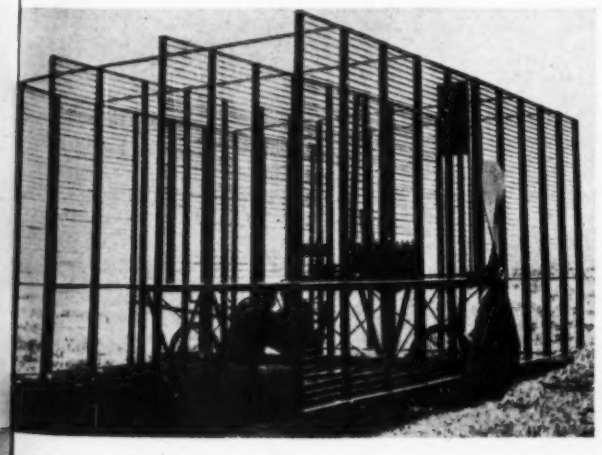
but this claim was not made until 1906, *nine years after the event*, when Ader heard about Santos-Dumont's tests.

1901 (October). W. Kress (Austrian). His promising tandem-wing floatplane hit an obstruction during its first attempt at take-off from Lake Tullnerbach, and was wrecked.

1901-02. Gustave Whitehead (American). The claim that Whitehead started flying in 1901, and made a seven-mile flight over Long Island Sound in 1902, has been thoroughly investigated by the American authorities, and found to be a myth. It started with an apocryphal story in the Bridgeport *Herald* of August 18, 1901, and then flourished like the green bay-tree.

1903 (August-November). Karl Jatho (German). On August 18, 1903, at the Vahrenwalder Höhe, Jatho rose for 59ft (18 m); by September 23 he had risen for about 98ft (30 m) (Fig. 2); and in November he made many take-offs, and rose for distances of up to 197ft (60 m). It is not known if the take-off surface was level. German historians do not claim that he made proper flights, but only that he was the first in Germany to leave the ground in a powered aeroplane under its own power.





igs. 3 and 4. Horatio Phillips' unsuccessful powered design of 1904 and, elow, his powered man-carrying machine of 1907, which took off and was airborne for about 500ft

1903. Preston A. Watson (British). His brother, the late J. Y. Watson, claimed in 1953 that Preston made a powered flight in 1903, before the Wrights. He was confronted with the results of much research, and finally admitted in a letter to me: "I make no claim that the machine that Preston used in 1903 . . . was a powered machine." He made a similar recantation in *Aeronautics* (December, 1955).

1903 (October-December). S. P. Langley (American). His tandem-wing *Aerodrome*, with C. M. Manly as pilot, was catapult-launched twice from a houseboat on the Potomac River (October 7 and December 8). On both occasions it fouled the launching gear and crashed. The deplorable story of its secret alteration by Curtiss, and his testing of it in 1914, needs no repetition.

1903 (December 17). Wilbur and Orville Wright (American). Their first *Flyer* rose four times under its own power and the pilot's proper control, from the level, within the space of 1½ hours on this date. The first time, Orville rose for 12 sec and covered about 120ft (470-600ft through the air); the fourth time, Wilbur flew for 59 sec, travelling for 852ft over the ground (half a mile through the air). If only the first take-off had been made, history would not have acclaimed it. As they were unique among the first pioneers in flying into a wind, it is only right and proper to assess them on distance travelled through the air.

By December 1904 they had made flights of over 5 minutes and done circuits. By October 1905 (with their No. 3 *Flyer*) they had achieved a fully practical manœuvrable aeroplane, and could stay up for over half an hour. No other aviator flew for over 59 sec until November 1907; or for half an hour until October 1908, when the Wrights were making flights of 1½ hours, which in December rose to over 2¼ hours, despite their being grounded from October 1905 to May 1908.

1905 (May). F. Ferber (French). His No. 6, the first man-carrying petrol-powered aeroplane to be airborne in Europe, and the first tractor biplane in history to be airborne, could not fly horizontally; but at Chalais-Meudon in May 1905 it made a creditable shallow "power glide."

1906 (March and August). T. Vuia (Hungarian). On March 6, 1906, Vuia was airborne for 39ft (12 m) in his tractor monoplane at Montesson, France. At Issy on August 19 he covered 79ft (24 m). Neither this nor the subsequent Vuia monoplane was successful, but it was the first man-carrying monoplane of basically modern configuration.

1906 (September 12). J. C. H. Ellehammer (Danish). After testing a monoplane tethered to a post in 1904, Ellehammer added a small extra wing above, and with an 18 h.p. motor left the ground in a free "hop" for about 138ft (42 m) on September 12, 1906, on the island of Lindholm, Denmark. This was said to be the best of a number of "flights." As Santos-Dumont was officially observed, his "hops" have been accepted as the first powered flights in Europe (see below). There was little to choose between the Ellehammer and Santos machines when it came to practicality: neither was in the least practical.

1906 (September-November). A. Santos-Dumont (Brazilian). In his canard biplane "14-*bis*" (50 h.p. Antoinette) at Bagatelle, near Paris, the Brazilian aviator rose for 23ft (7 m) on September 13, 1906; 197ft (60 m) on October 23; and 271ft (82.60 m), and 722ft (220 m) in 21 sec, both on November 12, 1906. On the last two flights octagonal ailerons were fitted in the outer box-kite wing cells. This machine flew only once more, in 1907, when it rose for 164 ft (50 m). The performance of October 23, and the second on November 12, were officially observed and (owing to the slow development of European aviation) were acclaimed and awarded prizes, as the first powered flights in Europe; yet (after all the abortive efforts made to fly since Chanute's visit in 1903) the criteria were pathetically low, and almost any airborne distance seemed a miracle.

1907. Horatio F. Phillips (British). One of the most distinguished pioneers in aviation history, famed for his aerofoil research in the 1880s, and his large multi-plane "venetian-blind" model tested successfully in 1893, Phillips appears now to be the first in Britain—and the first Briton in Britain—to take off in a powered aeroplane, under its own power, and make a powered hop-flight of about 500ft, this in 1907. A description and photographs (Figs. 3 and 4) of his two man-carrying aeroplanes, those of 1904—which was a failure—and of 1907, were the subject of a paper read to the Aeronautical Society by Col. J. D. Fullerton in May 1908 (see the *Aeronautical Journal*, July 1908), together with a statement by Phillips that in 1907 he became airborne half-way across a 1,200ft field, and came to a stop 30ft from the far side. The machine had its venetian-blind wings mounted in four tandem "sustainer frames"; it weighed 650 lb with pilot, and was powered by a 22 h.p. motor driving a 7ft tractor airscrew. In view of Phillips' previous achievements and his reputation, and the fact that he never claimed to have made proper flights, it is difficult—if not impossible—not to accept his 500ft "hop" in 1907 as a fact: incidentally, Octave Chanute accepted it in an article published in 1908, and he was no fool.

1907 (March-April). G. and C. Voisin (French). These two flew in turn on their biplane built for Delagrange. It first rose on March 16 for 33ft (10 m); then made some five more take-offs, the best of which were on March 30 (197ft; 60 m) and April 8 (164ft; 50 m). Modified, it was later (November 3, 1907) airborne for 1,640ft (500 m).

[continued overleaf

HOPS AND FLIGHTS . . .

1907 (July-December). L. Blériot (French). After "hopping" for a maximum of 20ft on his canard No. V monoplane, he built and tested his No. VI *Libellule* tandem-wing monoplane, covering 98ft (30 m) on July 11, and making his best distance of 469ft (143 m) on August 6. With his prophetic No. VII, with its "modern" monoplane look, he made short flights of up to 1,640ft (500 m) in November and December. Thereafter Blériot flourished.

1907 (September-November). Henri Farman (British). On a Voisin biplane at Issy, Farman was airborne for 98ft (30 m) on September 30, 1907; and 262ft (80 m) on October 1. Then every few days he covered longer distances, until on October 26 he achieved 2,529ft (771 m), thus beating Santos' best; and on November 10 he flew 3,379ft (1,030 m) in 1 min 14 sec, thus becoming the first European to be airborne for longer than Wilbur Wright's 59 sec on December 17, 1903. Farman had often modified this Voisin, with growing success. His subsequent career was spectacular. He remained a British citizen until 1937.

1907 (October-November). R. Esnault-Pelterie (French). His unconventional No. 1 R.E.P. monoplane, with its short fuselage (30 h.p. R.E.P radial), first rose at Buc on October 22 for 492ft (150 m); its best performance was 1,968ft (600 m) on November 16. Esnault-Pelterie persevered successfully with this type of machine, but it was away from the main stream of monoplane development.

1907 (November 13). P. Cornu (French). The first free vertical man-carrying helicopter ascent in history, near Lisieux. The Bréguet helicopter had left the ground on September 29, but it was steadied with poles, so the event does not rank as a free ascent.

1907 (November 17). A. Santos-Dumont. In his small monoplane No. 19 (later to develop into the *Demoiselle*) Santos-Dumont was airborne for 623ft (190 m).

1908 (May 14). Wilbur Wright. On this day Wilbur conducted the first passenger flight in history when he took up C. Furnas for 1,968ft (28⅘ sec) near the Kill Devil Hills. Furnas was then taken up by Orville. The machine was the No. 3 *Flyer* of 1905, modified to become a two-seater. It was previously believed that the first passenger flight was by the Delagrange-Farman *ensemble* on March 28; but it is now known that they never left the ground.

1908 (June). A. V. Roe (British). It is sad that so much controversy should surround one of the greatest men in British aviation, but it is surely important to be objective about him. It has been claimed that Roe made a number of "flights" of up to 150ft (later raised to 180ft) between June 8 and 28, 1908, in his biplane (re-powered by a 18-24 h.p. Antoinette engine) on the finishing straight at Brooklands race track. From the winning-post end of this straight, where Roe had his shed, rose the 1 in 12 "pull-up" slope.

No claims were made either by Roe or by his friends before March-April 1910. It is generally agreed today that the machine did leave the ground, and in two ways; as a glider towed by a motor car (as Roe himself stated in 1908), and as an independent powered aeroplane, which he did not mention until long afterwards. It is, of course, the latter that concerns us. Apart from the shortness of the hops claimed, the important point is whether Roe took off down the pull-up (i.e., with an accelerated take-off), or made his "flights" from the level. With his shed near the bottom of the pull-up, and the obvious help it would give him, it would seem extraordinary—even incredible—if any young inventor, with an untried aircraft, had not used it: yet Roe himself caused a statement to be published (February 1956) that "all his towed and flight trials were made on the level part of the finishing straight and not down the slope as stated, and it was at the other end of the finishing straight away from the slope that these flight trials were conducted."

Fig. 5. A. V. Roe in his machine at the top of the "pull-up" slope at Brooklands: a picture published on June 6, 1908, and now reproduced for the first time since that date

But there have now come to light in the French journal *La Nature* (June 6, 1908) two photographs of Roe and his machine—minus engine—one of them (Fig. 5) taken at the top of the pull-up slope in question, with the flat and upswept portion of the track at the Members' Banking behind, and the Members' Hill on the right. This, of course, does not prove that Roe later took off down the slope, but it shows it was very much in his mind.

To instance the fallibility of human memory, after a long interval, one of Roe's chief witnesses (even when re-examined) contradicted Roe and said that "on each occasion he started in front of the Paddock" (which was at the pull-up end of the finishing straight). So the verdict on the question of the accelerated down-hill take-offs must for ever remain in doubt. In his second machine (his first triplane) Roe was airborne for 900ft in July 1909; and in his third (the No. 2 triplane) he flew for half-a-mile in December 1909. Thereafter his career was brilliant.

1908 (July). J. W. Dunne (British). Information about this great man and his first machines is badly needed in view of the extreme paucity of surviving documents. His swept-wing stable biplane D.4, powered by a 20-25 R.E.P. engine, was tested at Blair Atholl, Scotland, in July 1908 (and later), a previous powered machine having made only glides in 1907. Dunne himself said that the D.4 "got off the level under its own power . . . but it was more of a hopper than a flyer." In view of his modesty, these "hops" might well have measured some hundreds of feet.

1908 (September-October). S. F. Cody (American, later British). After an engine test at Farnborough on September 19, and taxying tests on September 21, 24 and 28, Cody made what he called "only jumps" on September 29 and October 14, and his first flight (1,390ft) on October 16, 1908, this being the first powered and sustained flight in Britain. It has been claimed—many years after the event—that his first flight was the longest (150ft) of four take-offs on May 16, 1908. There is now proof that the claimants did not even know what this date was *until after 1948*.

The two principal witnesses of these alleged flights have also now given detailed descriptions of the tests, in which they flatly contradict one another about the time of day, the location, and the circumstances, one witness even denying the presence of the other. Finally, one of these two witnesses broadcast (on October 16, 1958) an account of the October 16 flight tacitly accepting it as the first flight. Full documentation exists for the tests from September 19 to October 16; none exists for May 16. The machine (Fig. 6) was named British Army Aeroplane No. 1.

1909 (April-May). J. T. C. Moore-Brabazon (British). Was the first Briton to make powered flights in Britain, when he flew up to 1,500ft at Leysdown during the week-end of April 30-May 2, 1909, on his second Voisin biplane (*Bird of Passage*), originally built for Farman as the Henri Farman II. It is not generally realised that Lord Brabazon—as he is today—had already made a flight of over three miles at Issy in February, 1909. On October 30, 1909, he won the *Daily Mail* prize for the first circular mile on an all-British machine (the "Short-Wright" No. 2; not one of the Short-built standard Wrights).

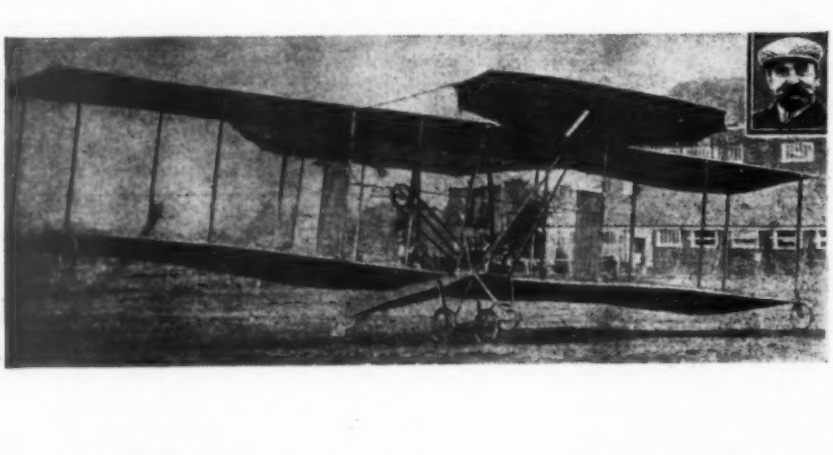


Fig. 6. The first published photograph of Cody's British Army Aeroplane No. 1, taken at Farnborough October 13, 1908, and published in the "Daily Mirror" the following day

Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.

The Airline Pilot Market

AS a commercial pilot and a regular reader of *Flight* I have been increasingly dismayed to see more and more flying clubs and centres advertising advantageous rates to prospective commercial pilots.

Whilst the principle is excellent on the surface it does tend to mislead young men into thinking, oh so wrongly, that here indeed is the possibility of entering aviation's ever-expanding sphere.

Young men who dare not previously think of aviation as a career can now look at their meagre savings and see there a C.P.L. and an occupation for life.

Articles in the "popular Press" (and occasionally, I fear, in publications which should and, I am sure, do, know better), still insist on referring to "the pilot-starved airlines."

Please let it be known once and for all that airliners are not "pilot-starved," and that employment as a pilot in these days of larger and larger aircraft and smaller and smaller crew requirements is more difficult to find than a needle in a haystack.

Several of my friends have qualifications which in the past have enabled them to hold the post of captain with concerns of repute. This summer these same men would in most cases be more than pleased to take positions as joy-ride pilots.

Please can you, Sir, find room in your valuable columns to print this letter before many more misguided enthusiasts help to swell the 400-odd unemployed pilots in the U.K. today and accelerate business in Carey Street?

Barking, Essex. D. AUSTIN.

[In a recent *Flight* article ("Club Training for Commercial Pilots," March 6) reference was made to "the current scarcity of opportunities for freshly qualified commercial pilots."—Ed.]

I WAS extremely interested to read the article on training for commercial pilots (*Flight*, March 6), as I myself am a sixth-former with limited financial resources endeavouring to become an airline pilot.

In the article, the scheme proposed by General Air Training Ltd. was mentioned and it was suggested that it was not successful owing to lack of support. Soon after this scheme was announced (late 1957), I obtained details and discovered that employment after training must be guaranteed for at least three years in order to pay back the loan. However, I found that on application to a number of operators, including B.E.A. and B.O.A.C., that none was sufficiently interested to sponsor me (or anybody else) and that in any case it would be impossible to guarantee three years' employment.

It therefore seems that it was the airlines that caused the downfall of this scheme and not lack of prospective pilots.

I was also interested to read in the November 28 and December 5 editions of *Flight*, an announcement by Ghanian Airways (an associate of B.O.A.C.) that Ghanian Nationals could apply for training as flight crew providing they had obtained G.C.E. "A" standard in maths, physics and chemistry. No previous flying experience was required. Trainees would receive part of their instruction in the U.K. and part in Ghana.

Is it possible that we may one day have a similar scheme whereby the two Corporations would train Britain's students to fly Britain's airliners?

Birmingham, 31. P. W. SNAPE.

Choice of a Freighter

COULD it have been the unemployment bogy that lost Hertfordshire's aircraft industry a £20 million order a few weeks ago? At the risk of incurring the charge of Æsop's sour grapes, I venture to suggest it was the difference between a 1.9 per cent local unemployment figure and a 9.8 per cent figure for Northern Ireland that turned the impressive Handley-Page 111 strategic-freighter project into an aircraft as extinct as the dodo.

Such a disastrous decision—to shelve what could have been the world's fastest, highest-flying, military transport aircraft—deserves a spirited protest from all those interested in preserving Britain's place as a top-ranking air power. We in the industry regard the Government's action—in selecting a ponderously slow turbo-prop machine in preference to a 600 m.p.h. pure jet—as the worst strategic folly. Indeed, with a General Election imminent, it is possible that political expediency has influenced their final choice.

A little over three months ago Britain's aircraft industry was justifiably aghast at the Defence Ministry's rumoured inclination to spend £20 million (in dollars) in buying the R.A.F. twelve American-built freighter aircraft. Our small, modern Army would, it was reliably stated, need long-range *jet* aircraft for quickly performed "fire-brigade" duties in quelling globalwise trouble outbreaks. According to reports in the national Press, however, vigorous agitation by Labour M.P.s, plus a near revolt by Tory back-benchers—all alarmed by the unemployment spectre in our aircraft factories—persuaded the Defence Minister, Mr. Duncan Sandys, to change his mind. It was officially announced we would *not* buy American aircraft.

Meanwhile, behind the scenes, a panel of experts were studying the advice of our air marshals' "Prospect" conference last spring, and the comparative virtues of three British-designed contenders for the newly conceived rôle of strategic "aerial fire-engines." In the running were: (1) the Bristol-Short Britannic, a Tyne-engined version of the Britannia; (2) the Vickers-Armstrongs VC.10, a pure-jet cousin to the Viscount and Vanguard; and (3) the Handley-Page 111 (or Treble One), a direct descendent of the Victor B Mk 2 bomber that had its successful maiden flight from Radlett in February. After a fortnight of Ministerial silence, two newspapers openly hinted that the Air Staff preferred pure-jet machines. The final choice, they said, rested between the VC.10 and H.P.111.

If speed, high-altitude and short runways were to influence the politicians and brass-hats, the Handley Page employees weren't worried. Indeed, they suspected that in order to offset the unemployment threat over their rivals in Belfast, a suggestion was made that would enable the H.P.111's fuselage structure to be made in Ulster; the wings and tailplane—that closely resembled those of the Victor Mk 1 and 2—were to be made at Cricklewood and Radlett.

The result we all know. For some reason—known only to the Government—they chose a Britannic with a top speed of 360 m.p.h. Even amateur strategists will agree this is a retrograde step.

The relatively slow, low-flying freighter—no matter how well designed—will be vulnerable to even the most impromptu attack in active service conditions. Unable to take the rapid-evasion prerogative of its jet counterpart, any turboprop will be an easy target for even second-rate jet fighters.

St. Albans, Herts. WILLIAM RICHARDSON.

[The Government has stated that the Britannic was chosen by reason of its adaptability to purely civil operations.—Ed.]

Beacon Power

IN your issue of February 13, in the article "Eastern Routes Jet," there is a contemptuous reference to the power of a non-directional beacon: ". . . only 100 Watts, about enough to light my 20ft living room . . ."

I would be obliged if I could have the freedom of your columns to point to a very commonly held error, that of referring to an NDB in terms of Watts without any further qualification.

The essential factor in deciding the effective range of an NDB is the amount of power actually radiated by the aerial system. To speak of 100 W leaves an ambiguity as to whether this is radiated power, radio-frequency power available in the transmitter output stage, or even in some cases the D.C. power supplied to the transmitter final stage.

If there is 100 W of radio-frequency power available in the transmitter output stage (this would be the commonly accepted interpretation) the radiated power would be less than 100 W, depending on the aerial efficiency. With an aerial efficiency of, say, 10 per cent the correct description would work out as "10 W radiated power."

Your readers may be interested in the following table of radiated powers necessary for NDBs of various ranges:—

Range (n.m.)	Watts Radiated
100	11
50	1
20	0.1
10	0.025

So much for house lighting!

Hounslow, Middx. A. JAMES BOURNE.

Machmasterpiece

I PROPOSE that your columnist Roger Bacon should offer a suitable prize for the best prediction as to the probable contents of the Auditor General's report on the Civil Appropriation Accounts for 1979-80. My own entry follows:

"The report deals mainly with the financial history of Britain's supersonic airliner, the Machmaster. It recalls that in 1960 the Treasury approved the placing of a development contract for the Machmaster with Super-Scruggs Aircraft Ltd., a consortium formed by various well-known British aircraft companies. The cost of the project was estimated by Super-Scruggs as £93m, and this estimate was approved by the Ministry of Supply with the proviso that a further £5,750 should be set aside for possible increases in costs of paper and telephone services. In 1961 Super-Scruggs reported that their original assessment of design man-hours had proved to be slightly optimistic and that the estimated cost of the project had risen to £382m. This was approved by the

CORRESPONDENCE . . .

Treasury on the recommendation of the Ministry of Supply with the proviso that the Government levy on future export sales of Machmasters should be raised from 2½ to 2¾ per cent.

"By 1966 the cost of the project had risen to £789m. This revised estimate, which was attributed to wage increases and the unexpectedly high cost of materials and structural development, was approved by the Treasury when B.O.A.C. signed a conditional letter of intent for 20 Machmasters.

"In 1971, following the first flight of the prototype Machmaster, Super-Scruggs submitted a revised estimate of £1,834m. This increase on the previous figure was stated to result from three main factors: (a) the need to have ten prototypes for development trials instead of two, as originally planned; (b) withdrawal of Air Ministry interest in the Machmaster programme, following the International Disarmament Convention of 1970; and (c) an underestimate of the cost of converting Sussex into a runway. The revised estimate was approved by the Treasury on the recommendation of the Interdepartmental Committee on Civil Aircraft Requirements, which reported that the international air transport industry was showing keen interest in the progress of the Machmaster.

"In 1977, the total cost of the Machmaster was re-assessed at £2,793m. This was stated by Super-Scruggs to be the outcome of factors outside the company's control, notably the high cost of litigation and compensation resulting from the demolition of 62 South Coast towns during 1975, when the third prototype Machmaster inadvertently exceeded Mach 3 at low level. The revised estimate was approved by the Treasury when American State Air Lines and Aeroflot Ltd. each signed options for five Machmasters, subject to satisfactory incorporation of special customer requirements.

"In 1979, when total actual cost of the Machmaster stood at £3,144m, Government support for the project was withdrawn. This decision followed B.O.A.C.'s cancellation of its letter of intent, which was stated by the Corporation to be a regrettable but inevitable corollary to the world-wide swing towards the subsonic, nuclear-powered, low-cost transport aircraft of the Massmaster type, as jointly developed by Douglas and Tupolev; in consequence of this trend the Corporation had been forced to order 20 Massmasters in order to secure its competitive position. The Ministry of Supply, in endorsing this decision, had stated that while the non-completion of the Machmaster project was unfortunate, much valuable experience had been gained."

Thames Ditton, Surrey. ROBERT BLACKBURN.

FORTHCOMING EVENTS

April 3-5. Aslib Aeronautical Group: Annual Conference.
April 4. British Interplanetary Society: "Radio Astronomy in Navigation, Guidance and Communication," by C. M. Cade.
April 5-12. Tiger Club: Aerobatic Training Week, Sywell.
April 6-9. R.E.C.M.F.: Radio and Electronic Components Show: Grosvenor House and Park Lane House, London.
April 8. R.Ae.S. Graduates' and Students' Section: "The American Aircraft Industry," by a member of the U.S. Attaché's Office.
April 9. R.Ae.S. (Main Lecture at Preston): "The Art of Developing Aero Engines," by A. C. Lovesey.
April 10. Helicopter Association: "French Helicopter Developments," by L. F. G. Legrand.
April 13. Institute of Transport: Brancker Memorial Lecture, "World Peace through Air Transportation," by Capt. E. V. Rickenbacker.
April 14. Institute of Metals: "Scientific Use of Space Exploration," by Prof. F. Hoyle.
April 15. Aircraft Recognition Society: a.g.m.
April 17. Institute of Navigation: "The Dectra Trials," by Col. C. Powell.

June 12-21. Paris Aero Show.
Sept. 7-13. S.B.A.C. Display and Exhibition, Farnborough.

R.Ae.S. Branch Fixtures (to April 10): April 6, *Derby*, "Design for Safety," by D. P. Huddie; *Glasgow* (Graduates' and Students' Section), a.g.m. April 7, *Boscombe Down*, "The Development of the Rotodyne," by Dr. G. S. Hislop; *London Airport*, "Power from Nuclear Energy," by Dr. D. M. Wood; *Luton*, debate. April 8, *Chester*, "Soviet Civil Aviation," by C. Jenkins; *Christchurch*, lecture; *Reading*, "Experiences of an Airline Pilot," by Capt. O. P. Jones; *Weybridge*, "The Operation of London Airport," by J. Jeffs. April 9, *Isle of Wight*, Lecture or Symposium by branch members; *Swindon*, film show.

THE INDUSTRY

English Electric Year

AVIATION activities by the English Electric Co. Ltd. and its subsidiaries were referred to by the chairman, Sir George Nelson, at the recent annual general meeting. Special reference to air matters was also made in the illustrated report on the company's 1958-59 activities, published at the same time. Sir George spoke of the formation of English Electric Aviation Ltd. during the past year, to take over the work of the company's aircraft and G.W. divisions, of Government orders for the Lightning and of the joint contract with Vickers-Armstrongs (Aircraft) Ltd. for the TSR.2. He said that D. Napier & Son Ltd., having received Eland orders from Canada, hoped to develop business with these engines in America and elsewhere.

Referring to Marconi's Wireless Telegraph Co. Ltd., the chairman said that its aeronautical division had had "an encouraging year," with the entry into B.O.A.C. service of Marconi-equipped Comet 4s and with the same equipment being supplied for those of Aerolineas Argentinas and East African Airways Corporation. During the past ten years the company had designed, constructed and installed nearly 70 major defence radar installations.

[Recent Marconi orders have included an M.o.S. contract for the planning, supply and installation of a high-power radio station at the R.A.F. staging post in the Maldive Islands; and an order from the Government of Jordan for the supply and installation of a long-range early-warning radar station with height-finding facilities and means of interception control.]

In his review of financial results, Sir George Nelson said that the profit of the Group after taxation and after deducting amounts attributable to minority interests had increased by £66,000 to £3,017,000.

Particular reference was made in the illustrated report to Thunderbird: its major problems were behind it and the company was "embarking confidently" on Service acceptance trials.

Goodyear Veteran Dies

WE regret to record that Mr. Paul W. Litchfield, honorary chairman of the Goodyear organization and an international figure in the rubber industry, died recently (at Phoenix, Arizona) at the age of 83. He had been associated with Goodyear for nearly fifty-nine years, having joined the company in July 1900 when it was an infant concern and subsequently playing a leading rôle in its expansion. He was successively a member of the Board, vice-president, president, chairman and (from 1940) chairman and chief executive officer. In 1956, however, he handed over his executive responsibilities to the president, Mr. E. J. Thomas; and in October last year he took the title of honorary chairman.

IN BRIEF

A party of technical officers from the U.S.A.F., the Air Ministry, M.o.S. and the major oil companies recently visited Treforest, South Wales, to see a three-day series of demonstration tests of water separator equipment developed and manufactured by Simmonds Aerocessories Ltd.

* * *

Trans-Canada Airlines have ordered twenty-one Mk 3 Autostairs from H. W. Edghill & Co. Ltd., mainly for use with their DC-8s. The Autostair was exhibited at Farnborough last year, the model then on show incorporating an Austin chassis. The Mk 3 version is larger, mounted on a Rootes Karrier Bantam chassis, and height is adjustable by a pump driven from the vehicle engine instead of (as in the earlier type) electro-hydraulically.

* * *

The first aircraft landing strip in the Sheffield area has been planned at Templeborough, Rotherham, for the private use of aircraft of the United Steel Companies Ltd. It is to be at the rear of the new Brinsworth Mill of the Steel, Peech & Tozer branch of the United Steel Companies and will run parallel with the Sheffield Road. Dimensions will permit use by light twin-engined aircraft.

* * *

The Industrial Division of Amplivox Ltd., Beresford Avenue, Wembley, have issued illustrated leaflets describing their range of lightweight noise-cancelling microphones, low-mass microphones for mask use and miniature earphones. This equipment is tropicalized and Service-approved. The fourth brochure illustrates recent developments in the widening range of Amplivox aircrew headsets.

* * *

From Cooper Brothers (Stockport) Ltd., Shrewsbury Street, Stockport, comes a leaflet illustrating their pedestal and bench models of the Tornado variable-speed drill, a machine which gives 18 indicated speeds over a range of production drills up to ½in. Speed changes are by a lever, without stopping the machine. Another leaflet illustrates the company's quick-change chuck for parallel-shank drills.

* * *

Recent orders for David Brown tractors include contracts for 55 vehicles for use at M.o.S. research establishments and airfields; for 12 from de Havilland Aircraft on behalf of Aerolineas Argentinas for the latter's Comet fleet; 27 for the Pakistan Air Force; and for 12 (a repeat order) for the Royal Norwegian Air Force. Four David Brown tractors were recently delivered to the Argentine Navy for use aboard their aircraft carrier *Independencia*.

SERVICE AVIATION

Royal Air Forces and Naval Flying News

Marshal of the R.A.F. Sir Dermot Boyle, G.C.B., K.C.V.O., K.B.E., A.F.C. (left), who is being succeeded as C.A.S. on January 1 next year by Air Chief Marshal Sir Thomas Pike, K.C.B., C.B.E., D.F.C. (centre). At right is A.V-M. H. D. McGregor, C.B., C.B.E., D.S.O., who on August 1 this year succeeds the C.A.S.-elect as A.O.C-in-C. Fighter Command. These changes are referred to on this page

Upwood Ceremony

PRINCESS ALEXANDRA is to visit R.A.F. Upwood, Huntingdon, on June 16 to present a standard to No. 35 Squadron. This was originally formed in 1916 and re-formed in 1929. During the Second World War it operated Battles and Blenheim 4s at first but subsequently Halifaxes, Liberators and Lancasters. It is now equipped with Canberra B.2s.

Seeing for Himself

ON the 41st birthday of the R.A.F. (April 1, last Wednesday) two visits were due to be paid to it by the Prime Minister. Mr. Macmillan was going first to the R.A.F. College at Cranwell and then to Cottesmore, to watch a Victor "scramble" and flying displays by the Lightning and the newly ordered AW.660. Further reference to these visits will be made next week.

Change at the Top

FROM January 1 next year Air Chief Marshal Sir Thomas Pike is to be Chief of the Air Staff in succession to Marshal of the R.A.F. Sir Dermot Boyle; and his present post as A.O.C-in-C. Fighter Command will be taken over on August 1 this year by A.V-M. H. D. McGregor, with the acting rank of air marshal. These appointments, announced on March 23, were briefly referred to in a news-item we published last week.

Marshal of the R.A.F. Sir Dermot Boyle, who is 54, was A.O.C-in-C. Fighter Command before he became C.A.S. at the beginning of 1956. He was the first Cranwell graduate to assume the R.A.F.'s highest post and his successor (also A.O.C-in-C. Fighter Command) will be the second. Sir Dermot had previously been A.O.C. No. 1 Group, Bomber Command, and he distinguished himself then and during his tour as C.A.S. as a Canberra pilot. When he took up his appointment he piloted a B.6 on a 20,000-mile tour of units in the Middle and Far East, and he made a similar flight in January this year (also in a B.6), covering 22,000 miles. He served in Bomber Command during part of the war, and then was S.A.S.O. at No. 83 Group and afterwards commanded No. 85 Group in 2nd T.A.F.

His successor-designate as C.A.S., Air Chief Marshal Sir Thomas Pike, is 52 and has been A.O.C-in-C. Fighter Command since August 1956. Before that he was D.C.A.S. and he had previously been A.C.A.S. (Policy) at Air Ministry and Deputy Chief of Staff (Operations) at AAFCE. During 1941 he commanded a night-fighter squadron, No. 219 [see p. 467], and he later served with No. 11 Group and the Desert Air Force.

Sir Thomas's successor as head of Fighter Command is A.V-M. H. D. McGregor, a 49-year-old New Zealander who has been Director of Air Defence at SHAPE since March 1957. Prior to that he had been for three years responsible for G.W. development with the Ministry of Supply, and his previous appointment was that of A.O.C. No. 2 Group, 2nd T.A.F. During the Battle of Britain he commanded No. 213 Sqn., and he later became S.A.S.O. at No. 82 Group and commanded R.A.F. Tangmere. He was five times mentioned in despatches and is an Officer of the Legion of Merit, U.S.A.

[See also leading article, *Tour of Duty*.]

NATO Fly-past

TOMORROW (April 4) the NATO tenth anniversary fly-past is to be carried out over Mainz, Germany, by AAFCE aircraft. It will be headed by a single V-formation of seven different types of machine flown by pilots from seven different countries (Belgium, Canada, France, the United States, Britain, West Germany and the Netherlands). This is the first time that pilots of different NATO nationalities have flown together as a single team. The British representative is F/L. C. Wilmot, flying a Hunter. In the wake of the V-formation will be 112 other aircraft, in seven different national groups of 16 machines each. Types represented will include F-84F Thunderjets, CF-100s and Sabre 6s, F-100 Super Sabres, F-101 Voodoos, F-102 Delta Daggers, Canberras and Mystère IVAs.

Old Sarum Command

TAKING up the post of Commandant at the School of Land/Air Warfare at Old Sarum on May 1 is A.V-M. D. R. Evans, who was S.A.S.O. at Fighter Command from the beginning of January 1957 until last October. He had previously completed the I.D.C. course (1956), been Director of Operational Requirements (B) at Air Ministry for three years, and before that a member of the J.S.S.C. directing staff. He won the D.F.C. in 1941 as a night-fighter pilot and is also a C.B. and C.B.E.

No. 2 Sqn. Reunion

A REUNION dinner for past, present and honorary members of No. 2 (A.C.) Squadron is being held at Williamsons Tavern, Groveland Court, Bow Lane, London, E.C.4, on Friday, April 10, at 6.30 for 7.30 p.m. (dress, lounge suits). As No. 2 is one of the most famous Army co-operation squadrons, it is appropriate that the C.I.G.S. (Gen. Sir Francis Festing) should have been invited to attend as principal guest.

The cost of the dinner, including wines and service charge, is 25s per head; and those who have not already done so should send applications and remittances—by next Monday, April 6—to S/L. C. S. MacDonald, R.A.F. Selection Board, Cranwell, Sleaford, Lincs.

Doubly Distinguished

A NEW distinction was conferred recently on No. 205 Sqn., which is the only R.A.F. unit still operating Sunderlands; for on March 20 it received its Standard, bearing battle honours of two world wars. The ceremony took place at R.A.F. Changi, Singapore; and the presentation was made by Air Marshal Sir Alick Stevens, formerly A.O.C-in-C. Coastal Command and a former C.O. of the squadron (in 1936).

No. 205 Sqn., commanded by W/C. R. A. N. McCready, has two Sunderlands remaining but its main operational equipment is now Shackletons. It first went to Singapore in 1930 and remained until the evacuation of Malaya in 1942. Personnel and aircraft were dispersed, but one of the Catalinas made its way to Ceylon, where the squadron re-formed. It returned to Singapore after the war, and has since undertaken a variety of rôles—patrols in the Korean war, sorties against terrorists in Malaya, and operations against smugglers and pirates.

Air Marshal Sir Douglas Macfadyen, A.O.C-in-C. Home Command (centre), at a recent farewell party at White Waltham to mark the closure of the Command on March 31. A. Cdre. A. L. Derry (A.O.C. Records Office) and A. Cdre. A. E. Clouston (A.O.C. Boscombe Down) are on his right and left respectively

One of the most pleasing air-to-air pictures of the first Vickers Vanguard, G-AOYW, is this study procured from a Viscount on an early test flight. Since the first flight on January 20 the Vanguard has flown more than 70 hr; a second aircraft (the first for B.E.A., G-APEA) is due to join the test programme in about a month's time. Before delivery 12 months hence about 1,500 hr will have been flown by five aircraft on certification and route-proving

AIR COMMERCE

SHORT SHRIFT FOR SHORT HAUL

COMPLETE figures are now available for Britain's air traffic in 1958. In the event the year turned out less badly than had been forecast twelve months ago. At that time it seemed that traffic might even suffer a slight fall. But the final figure for the year showed a rise of 5 per cent. This recovery was felt particularly on the medium and long stages.

Having had insufficient advance warning of last year's economic difficulties, carriers were unable to avoid scheduling excess capacity and total available capacity rose by 14 per cent. Load factor fell as a result from a marginal 63 per cent to an unprofitable 58 per cent.

A remarkable feature of last year's recession experience was that each airline was affected differently. B.O.A.C., which alone accounted for slightly more than one-half of Britain's total air traffic, enjoyed an 8 per cent rise in passenger traffic while freight fell by 5 per cent. B.E.A., on the other hand, increased their freight traffic by as much as 13 per cent while passenger-miles increased by only 4 per cent. The independents increased their freight traffic even more rapidly than B.E.A.—by 29 per cent—while their scheduled passenger mileage improved by 6 per cent and inclusive-tour traffic by 36 per cent.

Thanks largely to the economy-class fare, B.O.A.C. experienced a gratifying 26 per cent increase in passenger traffic on Atlantic routes. Freight showed a similar improvement. But on their Eastern and African routes the picture was less cheering: passenger and freight traffic fell by 5 and 13 per cent respectively. Much of this drop was due to a falling-off in business activity among most of the countries of Asia and Africa. But unscheduled delays resulting from technical faults must also have exerted a depressing effect on B.O.A.C. traffic in these regions.

B.E.A. felt the recession most acutely on domestic routes, where passenger traffic fell by 3 per cent. The independents fared even worse on their domestic services: passenger-miles were down by 6 per cent. B.E.A. managed to improve their freight loads on both domestic and international services, while the independents—largely thanks to the car-ferry activities of Silver City and Air Charter—increased their international freight traffic by 34 per cent.

From this otherwise confused picture one thing stands out—that the longer the stage length, the less the effect of recession. It would appear that traffic is most volatile on those routes where air travel saves the least time. Putting it another way, during a recession time becomes less precious.

QANTAS JOINS THE BIG LEAGUE

LAST week Qantas announced a firm date for 707 jet services between Britain and Australia—July 31. The service will be via the U.S.A.; jet services on the eastern (Kangaroo) route will follow "later in the year, as Qantas takes delivery of the rest of its jet fleet."

The plan on July 31 is for a 707 to leave London Airport at 1100 hr, bound for New York, San Francisco, Honolulu, Fiji and Sydney. It will arrive there at 1000 hr on August 2—38 hours after leaving London. It will be the inauguration of a twice-weekly service. As from August 18, there will be two weekly trans-Pacific services between Australia and San Francisco, terminating at the last-named city to connect with B.O.A.C. Britannias bound for London.

AIRBROKERS FIGHT RESTRICTION

THE latest annual report presented by the chairman of the Airbrokers Association provides a timely reminder of the difficulties placed in the way of non-scheduled air transport and of the efforts that are being taken on the Baltic Exchange to eliminate such obstacles.

Much publicity has been given to the restrictive attitudes adopted by Indian and Pakistani authorities for the protection of respective national carriers (see *Flight*, January 23). Not only do "no objection certificates" have to be obtained before clearance can be obtained but a tax is also levied on approved non-scheduled flights operated by foreign carriers.

The Airbrokers chairman took the opportunity of referring to the restrictions imposed by those governments usually considered to be liberal in their attitudes to air transport. The Canadian Air Transport Board confronts applicants seeking to operate non-scheduled flights with a formidable mass of documentation and also specifies various restrictive conditions which lay down a minimum period of notice, a maximum rate of agents' commission, and minimum quotations (tied on a percentage basis to the I.A.T.A. fare levels). The C.A.B. also specifies fixed charter rates. The attitude of the Airbrokers Association is that the amounts charged for non-scheduled flights should be entirely a matter for negotiation between carrier and customer.

In Europe—despite the conferring at Strasbourg—there is still little practical evidence of an easing of restrictions. Germany and Sweden, in particular, appear to have adopted a more severe attitude to foreign non-scheduled activities in recent months. Italy and Austria have also shown less encouragement to foreign charter operators: the services of the German independents have been particularly threatened in these two countries.

CONVAIR 540 SALES TOUR

THE Napier Eland-powered, Canadair-built Convair 540 has embarked on a series of three world sales tours. The first tour began on March 23, and is to cover 17,000 miles of the U.S.A. and Western Canada. A second 540 is due later this month to make a 25,000-mile tour of South America; and next month an aircraft will visit Europe.

The following are the points to be included in the North American tour: Utica, New York, Washington, Atlanta, Houston, Dallas, Fort Worth, Las Vegas, St. Louis, Chicago, Detroit, Minneapolis, Winnipeg, Edmonton, Calgary, Vancouver, Seattle, San Francisco and Los Angeles.

The South American tour will include stops at Havana, Barranquilla, Bogota, Lima, Santiago, Buenos Aires, Montevideo, Ascuncion, Porto Alegre, Rio de Janeiro, San Paulo, Salvador, Belem and Caracas.

No details are as yet available of the European tour. The whole demonstration programme will be jointly sponsored by Napier and Canadair.

"V.L.F." ON TELEVISION

LAST week, in the B.B.C. television programme *Panorama*, the proposed very-low-fare independent services were the subject of controversy. Those taking part were Mr. Keith Granville, deputy managing director of B.O.A.C., and Mr. Maurice Curtis, managing director of Hunting-Clan Air Transport. Mr. Woodrow Wyatt was the interviewer.

To air such a complex subject thoroughly in the beat-the-clock circumstances of television is an impossibility. It might have been much better in this case for Woodrow Wyatt briefly to have explained the issues involved, and then for the contestants to have argued about the *basic* issue—whether or not the proposed V.L.F. services will cause material diversion of the Corporations' traffic.

However, the discussion produced some illuminating irrelevancies as well as relevancies. Mr. Granville asserted that "B.O.A.C. have led the world in low-fare programmes," adding that the Corporation had been blocked [in I.A.T.A.] by the independents from introducing new low fares. Mr. Curtis did not answer that; but he pointed out that B.O.A.C.'s new low fares "were not new fares at all"—they were no lower than those offered on independent African Colonial coach services for six years past—and that therefore B.O.A.C.'s proposed fares would not generate any new traffic above what the independents had already generated.

Mr. Granville said that the independent fares "sound most attractive, I'm sure," but in fact it was not very difficult for anybody running an aeroplane or a bus to provide a very low frequency

AIR COMMERCE . . .

service at the time of year when the traffic was at its maximum and to get a very full load. B.O.A.C.'s responsibilities were day-in and day-out.

Mr. Curtis rejoined: "That is all pretty interesting, but of course not really effectual." They were not proposing to run "spasmodic services"; they were trying to offer the public the economics of their new aircraft [DC-6Cs] and to relate frequency to the *new* traffic—and he wanted to emphasize the word *new*. The independents were not "trying to swipe B.O.A.C.'s traffic." They would like to, but "laws govern this sort of thing."

Mr. Granville referred to the "monopoly" held by the independents on the low-fare African services, and hoped that "one day we shall be as privileged as they are."

Asked by Woodrow Wyatt whether the proposed fares were "economic, or just a bit of a joke," Mr. Curtis said that the independents were prepared to show all their figures to the A.T.A.C., who "can pull them to pieces if they can."

Mr. Wyatt concluded by saying that the problem was obviously much more complicated than he had at first thought: he "would not like to be the A.T.A.C. after Easter."

As a postscript, it seemed a pity that the B.B.C., with its reputation for impartiality and fairness, should not have asked a representative of Eagle—the independent which pioneered the very-low-fare proposals—to take part in the programme.

ELECTRA NOISE SUPPRESSION

LOCKHEED are investigating a new phenomenon which has apparently only recently manifested itself with the Electra. At high speed and low altitude, fuselage vibration in the plane of the propeller discs results in an increase in noise level. The effect is noticeable only at low angles of attack and at a particular inclination of airflow. According to *Aviation Week*, the remedies being considered are the installation of 43 tuning-fork-type sound-suppressors at various points on the airframe, and a 3 deg upward inclination of the engine thrust-lines.

An aircraft built for American Airlines has been taken off the production line and is to be instrumented for vibration tests; flight testing of the inclined nacelles is to begin shortly. Modified nacelles could apparently be incorporated at airline maintenance bases by exchanging engines for new quick-change units suitably modified. It is understood that no question of safety is involved, but Lockheed have recommended a reduction of high cruising speed from 324 kt to 288 kt pending investigation.

INVESTIGATING THE BOEING 707

THE first two days of the C.A.B.'s investigation at Idlewild into the "accident" to PanAm's Boeing 707 N712PA over the Atlantic on February 3 revealed very little about the causes of the sudden loss of height.

Evidence was given that the aircraft was flying at 35,000ft at Mach 0.82 and at a weight of about 195,000 lb. During the previous two flights the PB-20 autopilot was reported in one case to have caused a nose-down pitch and in another to have disconnected following a change of heading of 20 deg, but on February 3 operation was found to be normal on arrival at Gander. The disengagement warning light was fully dimmed.

Capt. Waldo Lynch, the pilot-in-command, said that the aircraft went into a sharp manœuvre downward and to the right. At 17,000ft the airspeed was over 400 kt, the electric trim button was inoperative, and his gyro horizon had tumbled. The co-pilot, Capt. S. T. Peters, recounted that "At 2,200 Z the navigator posted a change in heading requiring left turn. Used autopilot turn knob. Turn O.K. . . . Then light buffeting, plus positive load factor building up. . . . Heavy buffeting caused panel lights to fail."

The flight engineer, G. Sinsky, said that he was pinned to his seat as the Mach warning sounded. When the g load was relieved, he pulled the tailplane-power and autopilot circuit-breakers because he thought that the tailplane had "run away." Full nose-down tailplane inclination of 3 deg was indicated. He wound it back to the nose-up position but later trimmed nose-down.

The Bendix PB-20D autopilots in the Boeing 707 include control and stabilization in three axes, auto-trimming of the tailplane, height-lock, turn to preselected heading, glide-slope lock and manual bank- and pitch-command. Part of the autopilot, the comparator, samples the surface position-error before engagement can occur.

Another condition for engagement is that there should be a satisfactory power supply to the vertical gyro, which should not topple unless the supply is interrupted for 20 sec while bank angle exceeds 80 deg. There is 350 deg freedom in roll; but evidence given by the co-pilot (that the "position of the sky and moving stars showed the aircraft was on its back") indicates one reason for the horizon toppling.

The investigation is being continued in Los Angeles and Seattle.

AIRWORK'S SPRING CLEARANCE

THE most significant outward sign of the reorganization that has been going on within the Airwork group of companies over the past months is the announcement that most of Airwork's fleet is now being offered for sale.

The total fleet stands at four Viscounts, four Hermes, four Vikings and two DC-3s. The two Viscount 813s will be retained and will operate from Gatwick: the operation will be conducted by Transair (who already have two 807s) although the Safari services will probably continue for some time to be flown under Airwork colours. The two 736s will be sold. (Hunting-Clan, who have now placed 833s on their Safari services, are also disposing of their two 730-series Viscounts.)

The Airwork Hermes trooping contract to Singapore is now nearing completion—although details of the revised contract have not yet been decided—and three of these aircraft, together with spares and equipment, are being sold on a package basis for a sum reportedly as low as £45,000. The fourth Hermes is being returned to its owners, B.O.A.C.

These facts, together with the widespread dismissals among ground and flying staff, suggest that Airwork's existence as an active operator is drawing to an end.

MOSCOW IN THE SUMMER

LAST week, on March 25, the Minister of Transport, Mr. Harold Watkinson, announced that agreement had been reached between the United Kingdom and Soviet Governments about the operation of a London - Moscow air service by B.E.A. and Aeroflot. The air agreement drawn up in 1957 was finally brought into effect by the signature of both parties in Moscow on March 24.

It will be recalled that, though the two airlines have been eager to operate services since last summer, the U.K. Government have withheld approval on account of the Tu-104's noise. The Minister is apparently now satisfied that Aeroflot will employ Tu-104 operating techniques and procedures designed to minimize disturbance. No mention has been made of noise-suppressors having been installed on the Soviet jet airliner. "I am grateful to Aeroflot," said Mr. Harold Watkinson in the Commons, "for meeting, as far as they are humanly able to do, the rather strict operating requirements we had to set."

The service will probably begin in the middle of next month; B.E.A. will use Viscount 806s until Comet 4Bs become available next year, and Aeroflot plan to use Tu-104Bs. There will be one stop at Copenhagen. The operation of the Tu-104 into London will be reviewed . . . "to enable [the Government] to judge whether the initial conditions of operation should be varied."

DOMESTIC WITCH-HUNT?

THE C.A.B. has decided to investigate the Air Transport Association, the "club" of the American domestic airlines. There appears to be some mystery as to the precise reason for the investigation, which the Board feels will be in "the general interest of the public."

The Board's statement—to which so far it has been unwilling to add—speaks of the need for "a general inspection and review of the activities and practices of A.T.A. . . . to determine whether the Board should continue its approval of the organization . . . and if so whether such approval should be made subject to further conditions."

"Golden Jet" is the name given by Continental Air Lines to their first Boeing 707-120, which is due to be delivered next month. A fleet of four is on order. The unusual perspective of this picture gives the impression of an exceptionally high aspect ratio

AIR COMMERCE . . .

T.A.A. and the Friendship

An Instructive Pre-Delivery Episode

NEXT week Trans-Australia Airlines are to take delivery of their first Friendship—the first of a fleet of 12. This article discusses how T.A.A. and Fokker jointly and successfully tackled a difficult technical problem that arose before delivery.

A FEW months ago the airline industry grapevine was buzzing with rumours to the effect that the Fokker Friendship was in fatigue-test trouble. Like most rumours, there was enough in it to prevent Fokker and the airlines most concerned—Aer Lingus and T.A.A., the first main recipients of the Dutch-built version of the aircraft—from issuing a denial. On the other hand (again like most rumours) the "trouble" was much exaggerated. It is now cured, and everyone concerned has learnt something more about fail-safe versus safe life. In particular, the airlines most concerned will not forget the businesslike and responsible manner in which Fokker faced up to the problem.

What actually happened was that, one day last August, a series of cracks began to develop in a test specimen in the water tank at Schiphol. To be more precise, the lower (tension) skin of the Friendship's centre section—which was being tested attached to a pressurized fuselage immersed in the test tank—suffered serious cracks at between 16,000 and 20,000 "flights" of one hour each.

These failures occurred when six production aircraft had been built and many centre-sections assembled, and when Aer Lingus and T.A.A. were both looking forward to taking delivery of their first aircraft, well ahead of the contractual dates of November 30, 1958, and February 28, 1959, respectively.

The failures were serious because they could have meant that the certification authorities might not be prepared to approve a safe operational life of more than some 5,000 hr pending more conclusive results from further tests. Modification action, as described below, was immediately planned by Fokker.

Aer Lingus agreed to accept their first Friendships, unmodified, with a conservative and precautionary safe life and to return them to Fokker for modification before expiry of that life.

T.A.A. (with 12 aircraft on order) felt that they could not accept delivery on this basis. The Australian operators live as far from the Netherlands as it is possible to get, and they also utilize their aircraft at a very high rate. There was no point in taking delivery of aircraft which would probably need to be ferried twice more across the world within a couple of years of their acceptance. But T.A.A.'s reasons went deeper: it was their view that they could not accept in any new aircraft the possibility of a major modification or replacement of structure in a period of less than 30,000 flights (i.e., in T.A.A.'s Friendship operations, 30,000 hr).

Modification Decision

An engineering team under Mr. John Watkins, T.A.A.'s director of engineering, worked closely with Fokker in deciding the necessary modification action, and the Australian airline agreed to accept a postponement of six weeks on the contractual date of its first deliveries, again with a good prospect of the revised contract dates being bettered.

This action was influenced by T.A.A.'s strong view—held in the light of very satisfactory Convair 240 experience—that fail-safe structural qualities, as well as safe life, must be demonstrated. Fokker agreed, particularly as they realized that a scatter factor of at least five was necessary to demonstrate safe life—a fact which was not, in their opinion, conducive to structural efficiency. The Australian civil aviation authorities, it should be added, have strong views about the extreme difficulty of satisfactory safe life determination—views which might well some day be incorporated in Australian airworthiness requirements. Mr. Peter Langford, Director of Airworthiness of the Australian D.C.A., accompanied Mr. Watkins to Holland for the discussions.

The modification originally proposed by Fokker involved a change of material and a thickening of the skin by an amount calculated to reduce stress level by 20 per cent for a weight penalty of 80 lb. The skin material was to be changed from 75 ST to 24 ST, and skin thickness was to be increased from 2 mm to 2.5 mm. At the same time the thickness of the stringer sheet material was to be increased from 1.6 mm to 2 mm. This would reduce nominal 1g stress levels in the area concerned from 12,300 lb/sq in to 10,000 lb/sq in, and would provide the slow crack-propagation qualities and high residential strength of 24 ST material.

After considerable discussion and review of the many complex factors involved, from both design and production viewpoints, it was decided to make even more certain of achieving the desired result. In the end, the final Fokker proposal was for a skin thickness of 3 mm, but without changing the stringer dimensions. This was estimated to reduce stress level by 30 per cent instead of the 20 per cent offered by the 2.5 mm skin of the original proposal. This was agreed by T.A.A., who accepted the additional 35 lb weight penalty (i.e., 115 lb in all), and agreed also to the six-week extension of delivery beyond the contractual date.

Mr. Watkins spoke of the "realistic and co-operative manner in which Fokker have received our views, and the cordiality with which the discussions have been conducted." In his opinion, the modification should eliminate the possibility of the need for replacement or major repair within the 30,000 hr life agreed—"and this is far in advance of anything demonstrated or achieved in service by any other known type of aircraft."

As things stand now, the first T.A.A. aircraft for delivery is due to be handed over at Schiphol next Tuesday, April 7. Another will follow at the end of this month, another in May, and three more in June.

The contractual delivery dates of the second six remain unaltered; and T.A.A. expects to have its whole fleet of twelve by mid-October.

The first aircraft, VH-TFA, flew on January 16 in unmodified form, and immediately began certification tests of the Smiths S.E.P.2 autopilot, the air conditioning and refrigeration, and the radio and electrics. These tests lasted well into March, when the centre wing was retrospectively modified, and further production tests carried out. The disassembly and modification of the next three aircraft have already been accomplished. Hence -TFA will move back in order of delivery, and it is now expected to become the seventh acceptance. The other aircraft have been, or are being, modified in the assembly stage.

In the meantime, Fokker are carrying out tests of a modified centre section with the objectives of demonstrating not only a 30,000 hr safe life, but also fail-safe crack propagation-rates giving X-ray inspection intervals of not less than 1,000 hr. There will also be a limit-load test with one spar boom severed.

So far as the rest of the Friendship's structure is concerned, the fuselage suffered no failures of any significant nature during no fewer than 48,000 simulated flights. There was some progressive loss of pressure during the subsequent 1,000 "flights"; this was found to have been due to cracks developing close to the stiffeners of the rear pressure bulkhead. The Fokker designers were elated at the fact that none of these cracks had progressed beyond the bond between the skin and stiffeners and had thus proved the fail-safe nature of the design. Tests have since continued well beyond the equivalent of 100,000 flights.

The story of the Friendship's trouble provides a model for the ideal relationship between an airline and its supplier: recognition of a fault brought to light during an admirably early pre-service test programme; full and tough discussions of its implications and the necessary action; and a willingness on the part of the manufacturer—despite the penalties to him—to accept the views of the customer.

It might be added that, in this particular case, Fokker were fortunate to be dealing with an airline whose engineering standards and experience are recognized throughout the operating industry as second to none. To put T.A.A.'s safety record down in print is tempting Providence—but anyone who cares to check it cannot fail to be mightily impressed.

There is one other moral: it will one day become very difficult to sell airliners unless their fail-safe design is not just claimed, but actually demonstrated.

J. M. R.

A MATTER OF PRINCIPLE

EVER since the result was made known of the inquiry into the take-off accident to the C.P.A.L. Comet 1A at Karachi on March 3, 1953, I.F.A.L.P.A. have been attempting to show that the verdict that there was an error by the pilot, Capt. C. H. Pentland (who was killed in the crash) was not a just one. With equal tenacity, they have championed the cause of Capt. R. E. H. Foote, pilot of a B.O.A.C. Comet 1 which crashed when taking-off from Rome in 1952 in what were claimed to be broadly similar circumstances.

The Association have sought to show that, on the Comet 1, the margin between the unstick speed and the stalling speed was unreasonably small; not only because a pilot might make an error of one or two knots in following the unstick technique laid down in the manual, but because a margin in speed is necessary to cover the increase in stalling speed which must occur as the attitude of the aircraft is changed. At the weight at which the Comet 1A took-off at Karachi this was 5½ kt between the ground stalling speed and the unstick manual speed, and a further 3½ kt which was gained while the aircraft was rotated to its unstick attitude.

The pilots have been unbending in their attitude to the verdicts of the two accidents, and since the results of subsequent manufacturers' tests were made known have been pressing for new inquiries to be opened by the Pakistan, the Italian or the Canadian authorities, or by the M.T.C.A. All their efforts were unsuccessful and at one time they threatened to go on world-wide strike every March 3 until the Pakistan findings were reviewed.

With publication of a recent joint statement by I.F.A.L.P.A. and de Havilland relating to the accident at Karachi it seems that the pilots can at last feel that honour has been satisfied.

While de Havilland maintain that they have "throughout been satisfied that the techniques which they taught satisfactorily avoided any difficulties inherent in the somewhat narrow margin of speeds," and point out that no practicable increase in unstick speed would have safeguarded the aeroplane against consequences of departure from the proper technique, the pilots have obtained the manufacturer's recognition that "the aeroplane had a smaller margin for departures from its prescribed technique than contemporary piston-engined aircraft."

The prescribed technique was to raise the nosewheel at 80-85 kt I.A.S. and then return it lightly to the ground until the unstick speed was reached. At this speed, the Comet was to be lifted off by a firm, controlled movement of the control column until immediately after leaving the ground, when the column was to be moved forward again to check the vertical movement away from the ground and any tendency to pitch up; after which climb was to be initiated by a gentle backward movement of the control at 4 kt above unstick speed. If this technique was not followed, poor acceleration resulted from the unnecessarily nose-high attitude.

Following the accident, a series of extensive special tests were made. These showed that the stalling speed near the ground was higher than the corresponding free-air figure, and that this disparity increased with gross weight. A "wider margin for error" was obtained by modifying the leading edges of Comets and, as is widely known, is incorporated in the 1As and 2s now in service. The Comet 4 cannot be stalled at any weight during the take-off run, even if the tail bumper is pulled on to the ground.

Although no reference is made to the Rome accident in the joint D.H./I.F.A.L.P.A. statement, the implication is sufficiently clear for the Karachi and Rome incidents to be linked in current newspaper comment on the statement. Everyone must be relieved that at last the dispute is over, though the only really positive result is the proposal of new take-off requirements. These stipulate that the elevator control movement to initiate unstick shall not be made at a speed lower than 1.1 times the minimum speed at which the aeroplane can be made to lift off the ground and continue the take-off without displaying any hazardous characteristics. (An exception occurs in the case of aeroplanes with minimum speed limited by landing gear geometry or elevator effectiveness, when the factor may be reduced to 1.05.)

SOUTH AMERICAN JET

FROM Buenos Aires, from the camera of George Errington of de Havilland, come the lower three pictures of the arrival there last month of the first Aerolineas Argentinas' Comet 4. From left to right below are Peter Wilson, the D.H. pilot seconded to A.A.; D.H. technical representatives R. W. Sands and P. A. Hatswell; and J. Bridger of Waldron Aviación, D.H.'s local distributors. At bottom are (left) the welcoming crowd as seen by the disembarking passengers; and the general scene at Ezeiza airport, B.A., after the arrival. Note the Latécoère 26—probably the only surviving specimen of this French postal monoplane (450 h.p. Renault)—which was on show to provide a link with the early days of Argentine air services. On the right is the first published air-to-air picture of the first Aerolineas Argentinas D.H. Comet 4.

AIR COMMERCE . . .

ANOTHER ALTIMETER MISREAD

THE report of the investigation into the loss of B.E.A.'s Viscount 802, G-AORC, which crashed near Prestwick on April 28, 1958, was published last week. The conclusion is that the accident was caused by the commander (Capt. W. H. Hankin, D.F.C.) misreading the altitude by 10,000ft. At 4,500ft he read 14,500ft, and he "perpetuated the error of 10,000ft until the aircraft struck the ground some five minutes later." There was, in addition, "a lack of co-operation between the two pilots [the co-pilot was F/O. B. Fleming] and a lack of alertness on the part of the co-pilot."

Most people know that since this accident two others have caused the M.T.C.A. to order the replacement of existing altimeter presentations (*Flight*, March 6). It is therefore particularly interesting to study the final paragraph of the Prestwick inquiry report headed "Opinion": "Whilst a somewhat ambiguous presentation of height on the pressure altimeter may have initiated this misreading, a lack of co-operation between the captain and first officer and a lack of alertness on the part of the first officer were the main contributory factors."

This suggests, despite the conclusions of the report, that the "somewhat ambiguous presentation" must in fact have been the *primary* cause. There is no doubt that the report places major responsibility for the accident on the captain; and it remains to be seen whether—in view of the subsequent altimeter changes ordered—there will be a repetition of the kind of story reviewed on page 477.

Sir Lionel Heald, M.P. for Chertsey, last week asked the Minister of Civil Aviation if he was aware that the chief inspector "ignored" successive requests by the pilot, Capt. W. H. Hankin, to be fully heard and to call and cross-examine witnesses, and that Capt. Hankin had asked for a public inquiry, "having regard to certain important considerations of public safety and confidence arising from the use of a type of altimeter which is now being modified." The Minister's reply was non-committal.

Among the observations made in the report are the following:—

"Although he was not manually flying the aircraft because the auto-pilot was engaged, Capt. Hankin was controlling the descent and monitoring his instruments. On top of this he was doing all the R/T (the exchanges on which occupied about 4½ minutes of the 12 minutes between the start of the descent and Prestwick Beacon), writing down the weather reports, studying the approach and overshoot procedures, briefing the first officer on a possible overshoot, attending to descent and initial approach drills and checking the altimeters. There seems little doubt that in so doing he overloaded himself to an extent that made possible the mental loss of the descent sequence."

Capt. Hankin, 42, had completed 10,135 hr at the time of the accident, 9,000 of these being in command. His Viscount 800 hours were 766. F/O. Fleming, 39, had completed 5,260 hr, of which 544 were on Viscount 800s.

There were no passengers on board the aircraft, which was on a charter, and there were no fatal injuries among the five crew-members.

Footnote: B.E.A. last week announced that they have adopted a flashing light system which will warn pilots when their height is less than 10,000ft.

SIR ALFRED LE MAITRE

IT is with great regret that *Flight* records the death, on Sunday, March 22, of Sir Alfred Le Maitre, K.B.E., C.B.E., M.C., at the age of 62. From 1948 until his retirement in 1957 he was Controller of Ground Services at the Ministry of Transport and Civil Aviation. He was the first to hold this post, which was established by the merger in 1948 of the posts of Controller of Technical and Operational Services and Controller of Aerodromes. Sir Alfred played a leading part in the post-war development of all London's airports; one of the best histories of the development of London Airport was a paper he read before the Royal Society of Arts on March 27, 1957.

BREVITIES

Overseas Aviation have purchased from B.O.A.C. a third Canadair DC-4M Argonaut, G-ALHK.

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American Airlines are offering five DC-6As at $950,000 each, to be leased back from the purchaser at $22,000 each per month.

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A Douglas DC-8 will be demonstrated at Schiphol on June 21 and 22, after being exhibited at the Paris Show. It will subsequently be demonstrated in Copenhagen.

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Braniff Airways are reported to be studying the possibility of converting some of their Convair fleet to turboprop power. Both the Allison 501 and the Napier Eland are being examined. Braniff has 25 Convair 340s and six Convair 440s.

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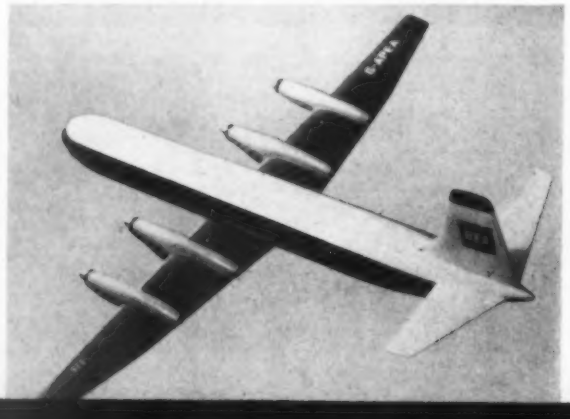
The dispute between S.A.S. and the Scandinavian Pilots' Association ended on March 24. There had been a lock-out of 600 Swedish crew-members—causing the cancellation of all S.A.S. intercontinental flights—at midnight on February 28, following rejection by the company of a claim for higher pay for flying DC-8s and Caravelles. Flights were restricted to limited European services manned by Danish and Norwegian crews who had previously reached agreement.

B.E.A.'s Comet 4Bs and Vanguards are to be painted in the boldest colour scheme yet adopted by a British airline. The wings will be bright red, both top and bottom, and the fuselage flash below the white decking will be black. B.E.A. squares will be red. A comment on the styling of B.E.A.'s aircraft, with a plea for brighter colour schemes, appeared on page 633 of "Flight" for October 17, 1958



Yesterday, April 2, the Handley Page Dart Herald was due to make a demonstration flight from Gatwick to Le Touquet, prior to its sales tour of India.

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The second prototype Friendship was damaged in Ethiopia recently after a belly landing. It is understood that the wheels were retracted too soon during take-off. The aircraft had been making demonstrations in Khartoum, Addis Ababa and elsewhere.

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The first non-stop flight from London to New York by a B.O.A.C. Comet 4 was made on Tuesday, 24 March, when G-APDH, commanded by R. C. Alabaster, made the flight in 7 hr 45 min from take-off to touch-down (8 hr 2 min chock to chock).

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Protesting against the increased U.K. airport charges, a delegation from the Foreign Airlines Association saw the Controller of Ground Services, Mr. E. A. Armstrong, at the M.T.C.A. on March 20. The delegation was led by Mr. W. H. Whelan of Aer Lingus. No statement was issued.

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Rolls-Royce, who have developed Comet 4 and 707-420 sound-suppressor nozzles, have entered into a patent licence agreement with Power Jets (Research & Development) Ltd. The patents cover inventions which resulted from original work on sound suppression done at the College of Aeronautics (Cranfield) by the inventors, Professor A. D. Young and Messrs. G. M. Lilley and R. Westley.

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A newspaper report last week to the effect that Pan American will allocate one 707 to transatlantic cargo was subsequently described by a London spokesman for the airline as "completely without foundation." The report suggested that Pan American, having obtained I.A.T.A. approval for bulk consignment cargo-rates, would devote one jet entirely to this work, thus dominating the market.

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Mme. de Gaulle named the first Air France Caravelle *Lorraine* at Orly on March 24. Air France will receive the first four of their 24 Caravelles before mid-April, followed by five more during the year. The 1960 schedule calls for one delivery in each of the months of February, March and April; two in May; one in June; two in July; one in September; two in October; two in November; and two in December. Passenger services will be inaugurated from Paris to Athens and Istanbul via Rome (four times a week) and via Milan (three times) on May 12. The prototype 02 Caravelle, incidentally, is on a two-month lease to S.A.S. in Stockholm for crew-training.

[redacted]